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AN EXPERIMENTAL COMPARISON OF DIFFERENT METHODS OF VISUAL INSTRUCTION

A DISSERTATION

Submitted to the faculty
of the Graduate School of Arts and Literature
in candidacy for the degree of
Doctor of Philosophy

Department of Education

By

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Chicago Illinois August 1922

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INTRODUCTION

Visual education is not new. The development of the art of photography in the realms of still and motion pictures is new. This development has been so rapid that the child of today is confronted on all sides by the pictured world. The illustrated newspaper, the illustrated magazine and the moving picture theatre all present their story to the child mind.

The present movement for visual education received its impetus in large part from the development of the moving picture yet the use of motion pictures in the classroom is still a novelty.

Every new movement owes its initial impetus in part to the novelty of its attack upon the same old problems. Herein lies the possible source of collapse in the movement since that which is new today is old tomarrow. Visual education should not run the risk of being discarded simply because one of its largest sources of materials is to be found in the motion picture. The chart, the diagram, the still picture, the model, the stereoptican slide and the stereograph claim the right to as much attention as the motion picture. Moving picture instruction is not the sum total of visual education.

What is visual education? Visual education is that instruction as to represented or actual physical objects through the sense of vision. These objects may be divided into three large groups; first, real objects in their natural settings; second, real objects taken from their natural settings; third, objects and processes represented by means of charts, photographs, motion pictures, models, maps, stereopticon slides, stereographs and sketches. Visual educators are deeply interested in the third group because it involves the use of photography in all its forms.

The first problem of the visual educator, then, is to determine which of the three groups listed above has the greatest value in the school, and the second is to decide the relative value of the different materials which might be listed in each group. In addition to these first problems, there arises a third and a fourth, namely, the determination of the best methods of teaching with the materials of visual instruction and the improvement of the mechanics of re-presentation.

Educational research with visual materials up to the present time has concerned itself largely with a

determination of the relative value of the different items listed in group three above. These experiments for the most part were centered in a comparison of the motion picture with other forms of presentation.

The first experiment in visual education was conducted at Columbia University by J. V. Lacy during the school year of 1918-19. The purpose of this experimental work was to "determine the pedagogical and moral value of motion pictures." The following quotations describe the work of Lacy as reported in the Teacher's College Record for November 1919.

> "These experiments compare the efficiency of three typical methods of presenting a story to pupils: (1) silent reading of a story by pupils, (2) oral telling of the story to pupils, and (3) presentation of the story to pupils by means of motion pictures.....
>
> The questions which the investigation was designed to answer were; (1) which method gives pupils the most factual knowledge? (2) which method stimulates the largest amount of thinking or inference? (3) which method most improves the ability of pupils to make moral discriminations? (4) which method is most interesting to pupils?.........
>
> The data tabulated support the following conclusions:
>
> Under the conditions of our experiments, questions of fact, inference, or moral discrimination can be answered more

> adequately when the narrative material has been presented by a storyteller or as reading matter than when presented through the motion picture; of the two more successful methods of presentation, the story-telling has the advantage....
>
> "Our results would indicate that the order of effectiveness of the various methods, where appeal to interest is concerned, is exactly the opposite of that which obtains if the ability to reproduce and apply the material presented is considered....
>
> "Under the conditions of our experiments, questions of fact, inference, or moral discrimination can be answered more adequately upon delayed recall when the narrative material has been presented by a story-teller or as reading matter than when presented through the motion picture; of the two more successful methods of presentation, story-telling is the more advantageous."[1]

A critical evaluation of Lacy's work can be summed up in his own words, "the investigation should (have been) supplemented by experiments which would (have eliminated) any constant error due to the fact that but one motion picture and one story-teller were introduced."

---

[1] J. V. Lacy. The Relative Value of Motion Pictures as an Educational Agency. Teachers College Record. Vol. 2o, November 1919, pp. 452-65.

(The tense of the words in the brackets was changed to conform to context.)

(This)investigation, therefore, can make no claim to completeness, nor does it make possible a final estimate of the relative value of motion pictures as an educational agency."[2]

An examination of the data on which Lacy bases his third conclusion quoted above shows that, "the differences between the various methods of presentation are less in the tests for delayed recall than in the original ones."[3] In other words the *per cent of loss* from the motion picture presentation was lower than in the oral presentation and reading presentation. Furthermore, the reading presentation shows a lower percent of loss than the oral presentation.

A second experiment which has been reported in the field of visual education was conducted in the New York public schools during the school term ending June 1920.

The experiment "was intended to demonstrate the adaptability of the use of the stereoptican pictures to classroom work in geography."

The experiment was begun by W. Crandall Director of Lectures and Visual Instruction of the New York

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[2] Ibid, p. 457.
[3] Ibid, p. 455.

public schools in cooperation with Abrams, Chief of the Bureau of Visual Instruction of the State Department of Education.

A report of the experiment sent out by the Bureau of Reference, Research and Statistics of the Public Schools of New York City draw the following conclusions from the research:

> "That the comparative tests conducted were limited to certain phases of geographical instruction which could be most readily tested.
>
> That in these tests the experimental schools which had employed visual aids did very much better than the schools that had not employed such aids.......
>
> The recommendation is made that a similar experiment be conducted under more properly controlled conditions in other grades so that more conclusive evidence may be gathered." 1

The function of the Bureau of Reference, Research and Statistics in this experiment was only that

Unpublished,
1. "Report on geography tests given to 6A classes in seven schools using Visual Instruction as an aid in teaching and in seven schools following the ordinary Methods of Instruction", by Bureau of Reference, Research and Statistics New York Public Schools. 1920.

of a testing agency called in at the end of the period of experimentation. Hence, many of the significant conditions which should be the subject of control in any scientific experiment were beyond its control. The interpretation of the results was clouded by this lack of controlled conditions.

The most outstanding piece of research in the field of visual instruction to date is the work of J. J. Weber at Columbia University. The following summary of his material is taken from the Moving Picture Age for July, 1922.

(A paper by Joseph J. Weber, Associate Professor of Education, University of Kansas. Read before the annual session of the National Academy of Visual Instruction, at Lexington, Ky., April 1922.)

INFLUENCE OF MOVING PICTURES UPON CHOICE AND CONDUCT

How great is the influence of moving pictures upon the behavior of school children? In answer to this question I conducted an experiment. Four factors were selected for comparison: (1) the printed page, (2) the teacher, (3) the silent film, and (4) the film accompanied by remarks. The experiment was conducted with nearly twelve hundred seventh-grade pupils of Public School 62, which is situated in the lower east side of New York City.

The following tests were employed:

> 1. Suppose a rich family offered you an opportunity to accompany them this summer on a trip to Alaska where you could climb mountains and see real glaciers. And suppose another rich family gave you the chance to spend the summer with them in a camp in some Canadian woods where you could hunt and fish and go canoe-riding--
>
> Would you choose to go to the camp, or would you go to see the glaciers instead?
>
> 2. Write a short composition (50 words or less) on one of these three subjects: choose one only:
>
> How I Spent My Easter Vacation
> The Story of a Mountain Glacier
> What I Hope to Be When I Grow Up
>
> 3. Suppose your parents wanted to give you a book for a birthday present. If they showed you the following list and asked you to indicate the one you

liked best, which one would you select? Check one only.

The Old Testament
Longfellow's Poems
History of the World War
Glaciers of North America
Little Women, by Louisa Alcott
Hunkleberry Finn, by Mark Twain

In the foregoing three tests a significant subject is common to all, namely, mountain glaciers. This happened to be the subject of the lesson that one group of pupils read from the printed page, another group heard from the lips of the teacher, a third group saw depicted on the screen, and a fourth group saw on the screen and heard commented upon by the lecturer.

All the remaining subjects are merely strong counter-attractions. In the first test the counter-attraction is a summer camp; in the second test the counter-attractions are the Easter vacation and the school pupil's ambition for adulthood; and in the third test the counter-attractions are five books of varied appeal, such as the History of the World War and Huckleberry Finn.

Now the question is: Which of the four groups would choose the subject suggested by the lesson oftener than the counter-attractions? Or, stated differently, which factor would have the greatest influence upon choice? Would the moving picture arouse greater interest in the pupils than either the teacher or the printed page?

Before I answer the question, I want to state that the experiment was repeated three rimes with the groups shifted along each time so that in the end each group had been under the influence of each of the four factors. For the second week the significant subject was "The Earth and Worlds Beyond"; for the third week, "The Southern States"; and for the fourth week, "The Growth of Cities and Their Problems." This rotation served to insure statistical reliability.

"Attention is called to the fact that the first and last tests are preference measures, while the second is a bona fide conduct test--the pupils actually wrote a composition.

"To give a detailed summary here would be confusing; so I have combined the teacher and the printed page into what may be called the verbal factor, and the two film showings into the pictorial factor.

"The verbal factor effected 1,826 choices for the subject suggested by the lesson, and 1,331 for the counter-attractions. The pictorial factor, on the other hand, effected 1,860 for the subject and only 1,298 for the counter-attractions. This represents a gain in the numerator of 34 choices and a corresponding loss in the denominator of 83. Altogether about 58 out of some 3,200 choices yielded to the influence of the moving pictures. this means a gain of about 2 per cent.

"In conclusion, while we cannot yet say what is the exact influence of moving pictures, we have strong evidence that it is greater than that of either the printed page or even the teacher upon the behavior of our boys and girls.[1]

1. The experiment is described in full in my doctor's thesis, which is now in the hands of the printer and will appear before long. [1]

1. Joseph J. Weber, Influence of Moving Pictures Upon Choice and Conduct. Moving Picture Age, Vol.V, No. 7, Pp.14-15.

A critical evaluation of Weber's work cannot be made until his thesis appears from the press.

A number of so-called experiments in the field of visual education have been reported in the newspapers. These experiments when traced to their source prove to have been conducted in such a slipshod and simple fashion that little reliance can be placed on their conclusions.

It is obvious, then, that the research in visual education has only scratched the surface of the field. Scientific data will only be accumulated through long years of careful and painstaking investigation.

The experiments which are reported in the following pages are attempts to contribute a mite to the store of knowledge which will be accumulated.

The experiments, fourteen in number, are described in chronological order so that the reader can fully appreciate the development and refinement of the technique of experimentation as the work progressed.

The problems attacked in these experiments all fall under the head of the second large problem

outlined above namely, the determination of the relative value of some of the materials listed in group III. This determination will be found to be in terms of a comparison of the factual knowledge acquired by pupils thru an exposure to different presentations supplemented by visual aids.

The writer wishes to acknowledge his indebtedness to Dr. F. N. Freeman of the University of Chicago for his inspiration and guidance throughout the conduct of the experiments, and to the superintendents, principals and teachers of the school systems in which he worked for their hearty cooperation and assistance.

CHAPTER I

Experiment -- 1.

PROBLEM. The work accomplished by the Society for Visual Education represents one of the first attempts to produce moving pictures for school room purposes under the direction of educators. These films, illustrative of some of the traditional topics in the curriculum, afforded an excellent opportunity to compare the efficiency of this new medium of instruction with other methods. Experiment one, conducted at the University Elementary School of the University of Chicago purposed to show the relative efficiency of the moving picture film and the teacher in transmitting to pupils the information contained in a selected unit of subject matter.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. Thirty-two seventh and eighth grade pupils in American history were selected to act in the capacity of subjects for experiment one. The intelligence quotient of each subject based on the Illinois Intelligence Examination was obtained from the records in the

principal's office and two comparable groups were formed by placing every other pupil in rank order of I. Q. in group "A" and every other pupil in rank order starting with rank two in group "B".

Previous to this experiment this class had been given some instruction in learning from films in connection with an informal experiment with the film titled, "The Influence of the Steamboat on United States History."

(2) Topic. The title of the moving picture film selected for experiment one was, "French Explorations in North America" produced by the Society for Visual Education, Incorporated. The scenario for the film was edited by W. C. Bagley.

The oral presentation of the same topic, "French Explorations in North America," followed the film's outline as closely as possible. The teacher of history in the Elementary School of the University of Chicago presented the oral material using a blackboard map to illustrate the routes traversed by the French in their explorations.

(3) Presentation of the topic. The regular class period for history on May 13, 1921 was used for the experiment. Group "A", which we will call the "oral group", and group "B", which we will call the "film group"

were assembled in a history class-room. The children were informed that those who were in group "A" were to remain with their teacher, Miss Vail, and those who were in group "B" were to go with the writer when the proper time arrived. The following instructions were then given to the children by their teacher.

> "Today we are going to tell you the story of the French Explorations in North America. I am first going to read to you a part of this story, then group B will go with Mr. McClusky to see a film on French Explorations while group A will hear me tell the same story. You must pay strict attention to every thing you see or hear because you will all be given a test to find out what you have learned about the French Explorations. Every-one pay attention now while I read."

Miss Vail read the following material to the pupils. (The time taken to read this material was five minutes.)

Discussion -- History 1.

THE FRENCH EXPLORATIONS IN NORTH AMERICA

> "If the French had not conquered Canada, pushed into the region of the Great Lakes, built their forts upon the Mississippi, and gradually pressed eastward toward the frontiers of the English colonies, the history of the American people would have followed a quite different course. It is fitting, then, to emphasize the salient features of this French movement of exploration and exploitation as an essential

background against which to view the early development of our country.

To the accidents of geography, many of the events of this period are due. The French happened to be the first settlers in the only region that offered an easy access from the Atlantic seaboard to the interior of the continent. Once established at Quebec and Montreal, the open gateway lay before them. Their canoes and bateaux could be poled up or carried around the rapids. They could pass up the Ottawa River, and by an easy portage to Lake Nipissing they could reach Lake Huron; or the *voyageurs* could skirt the shores of Ontario, carry their canoes around the falls and rapids at Niagara, and launch them again on Lake Erie. From either point of vantage, the great central valley of the continent lay at their feet. Almost a score of practicable waterways obstructed only by low and narrow portages led to the Mississippi and Ohio rivers, through the White, the Fox, the Des Plaines, the St. Joseph, the Maumee, the Cuyahoga, and other rivers draining into one or another of the Great Lakes.

But the very wealth of possibilities had its disadvantages. It meant a scattering of effort. It meant a constant temptation to the exploitation of the fur-trade, which thrives only in vast stretches of thinly populated territory, and to the consequent neglect of permanent and stable settlements, the building of homes, the development of farms and factories. It meant the dominance of the trader and the trapper, the wanderer and the adventurer. It meant the far-reaching influence of the Jesuit priest with his efficient methods of enlisting the friendship and retaining the loyalty of the Indians. It meant safety for the Indians themselves, for the fur-trade not only did not disturb them in their nomadic habits, but gave their mode of life a new value.

> The accidents of geography, then, determined in part the character and extent of the French occupation; but only in part. The character of the French settlers and the government under which they lived encouraged exploitation rather than settlement. It was not the sturdiest of the French stock that formed the backbone of New France. Lacking among the French immigrants were the deep motives which inspired so many of the English colonists to seek real and permanent homes in the New World. Lacking, too, were the spirit of self-reliance and the tradition of local self-government which the English brought with them from the Mother Country. These differences were fundamental, and to understand them is essential to an appreciation of the institutions and ideals which constitute the basic elements of American nationalism today. It was, however, the geographical setting that led so significantly to the development that needed only the unifying effect of the French and Indian wars and their aftermath to fuse the separate elements into the embryo of a great nation.

As soon as this five minute preliminary discussion was finished, group 3 passed to the projection room three doors down the hall. (The projection room was a class-room used by the School of Education.) The pupils were seated in front of the film. The writer acted as operator and before the actual showing of the film began, the writer spoke to the children as follows.

> "We are ready to begin now. Pay strict attention to the film."

The time consumed in showing the film was twelve minutes (timed by the writer's watch.) The pro-

jector used was an Optigraph. The room was dark and the projection excellent. The silvered screen was a part of the equipment of the room. In order to acquaint the reader with the subject matter in the film, the outline of the film is reproduced herewith from the syllabus sent out by the Society for Visual Education.

Outline of Contents - History I

(Titles underlined.)

FRENCH EXPLORATIONS IN NORTH AMERICA

Published by the

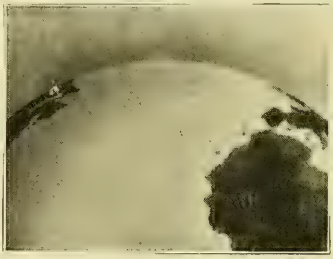
SOCIETY FOR VISUAL EDUCATION, Inc.

(Cuts illustrate the captions under which they are placed. These cuts were made direct from the film.)

Curve of globe shown with vessel of style of 1600 sailing from France to Gulf of St. Lawrence.

French reached St. Lawrence River in 1606: Voyage in 13 Weeks.

Trip completed. Scene dissolved into animated map of North America. Explorers' route indicated by a line moving from the east, passing south of Newfoundland up the St. Lawrence, to Quebec, on to Montreal.



Trip completed.
Vessel at left of picture.

"Mount Royal"
Reproduction of an old print.

"Early Montreal"

Reproduction of an old print.

French also explored Great Lakes

Map of Great Lakes appears

First route via Ottawa River

Animated line follows route up Ottawa River

Dotted lines are portages

Shown by animated map

Route: across land to Lake Nipissing, then by water to Lake Huron.

Another route through Lake Ontario

Animated line begins again at mouth of Ottawa River and continues up the St. Lawrence, along north shore of Lake Ontario to mouth of Niagara River and a little way up that river.

Map of Niagara River

Exploration line continues in the "close-up" map to a point below the falls, where the portage route is indicated by a dotted line.

Canoes were carried around rough water

Reproduction of old print of "A Portage".

A Portage

Motion pictures of men carrying canoes around falls.

A real action picture.
The canoe is on the back of the man.

The Gorge

Motion picture views of the gorge

Hennepin's drawing of the Falls

Reproduction of Hennepin's own drawing.

The Falls

Motion pictures

Rapids above the falls

Motion pictures

Building GRIFFON - First ship above the falls

Reproduction of old print

French explored all Great Lakes

Shown by animated map
Route: from point above Niagara Falls along north shore of Lake Erie, up Detroit River to location of Detroit.

The built fort and store at Detroit

Location of Detroit shown on large scale map; and animated exploration line continues up Detroit River, thru Lake St. Clair, St. Clair River, thru Lake Huron, along S. W. shore of Sts. of Macinac (location of St. Ignace and Fort Michillimackinac indicated) south long western shore of Lake Michigan and thru Green Bay to its head. Other routes are shown from Michillimackinac down eastern shore of Lake Michigan to St. Joseph; and from St. Ignace along Upper Peninsula shore to St. Mary's River, up to the Rapids (location of Sault Ste. Marie indicated() and along southern shore of Lake Superior to present site of Duluth.

Sault Ste. Marie District

Reproduction of old print

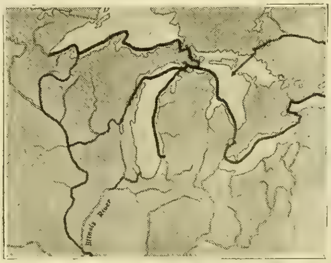
View on Lake Superior

?

Reprodution of old print

French Routes into Ohio and Mississippi Valleys

The main routes are shown by a series of animated lines on the map.
Route 1: from Lake Superior up the White River (near the present site of Ashland, Wis() to the St. Croix River, down the St. Croix to the Missippi, thence down the Mississippi.
Route II: from head and Green Bay up the Fox River to Lake Winnebago, through the Lake, on up the Fox River to a portage, across and down the Wisconsin to the Mississippi, shown by moving line.



The main routes
shown by animated lines.

Hennepin at a Portage

Little Falls of the Mississippi

Reproduction of an old print

La Salle and Hennepin on the Mississippi

Reproduction of old print
Motion pictures of woodsmen's canoes on the upper Mississippi.
Route 3: from present site of Chicago up south branch of Chicago river, portage to the Des Plaines, along the Des Plaines and the Illinois to the Mississippi--Shown by moving line.

Ruined French fort near St. Louis

Reproduction of old print

La Salle

Reproduction of portrait
Route 4: (shown by animated map) from Lake Michigan up the St. Joseph, portage to the Kankakee, down the Kankakee, and the Illinois to the Mississippi- Shown by moving line.

Western routes developed first: Indians were least dangerous there

Route 5: shown by animated map) from present site of Toledo up the Maumee to the present site of Fort Wayne, Ind., portage to the Wabash, down the Wabash and the Ohio to the Mississippi.
Route : from the present site of Sandusky, up the Sandusky river, portage to the Scioto, down the Scioto to the Ohio, down the Ohio.

Route 6: from the present site of Cleveland, up the Cuyahoga, portage to the Muskingum, down the Muskingum and the Ohio.
Route : from the present site of Erie, portage to French Creek, the Allegheny, and the Ohio, shown by moving line.

The map showing all the routes traced by the moving line.

French were traders and missionaries, founding few settlements.

This map outlines the region explored by the French before 1750

The map as a whole is shown, with exploration lines completed, to fix the lines in the pupil's mind.

An examination of this outline shows that a large proportion of the film is devoted to still pictures, maps and captions. The actual proportion of each of these phases of the film is given on page 561 by the footage measurement of the film itself. (See chapter 15 for a discussion of this point.)

During the time the film was shown to group "B", Miss Vail was giving group "A" its oral instruction. She used a blackboard map to illustrate the routes taken by the French. The routes were traced on the blackboard map as shown by the film. This instruction was given to the pupils in their regular history class-room.

The time consumed by the oral presentation was twelve minutes. (Timed by the teacher's watch.) Miss Vail followed the telling or lecture method in her presentation.

The outline of the oral material given by Miss Vail is as follows:

FRENCH EXPLORATION IN NORTH AMERICA

Tell how French in 1600 sailed from France to Gulf of St. Lawrence. Indicate this on map before class.

The French reached the St. Lawrence River in 1635. Voyage took thirteen weeks. Indicate the explorer's route by a line moving from the east, passing south of Newfoundland, up the St. Lawrence to Quebec, on to Montreal.

The French founded Montreal and Quebec on the St. Lawrence River. Show their location on the map.

The French also explored the Great Lakes. Indicate on the map the location of the Great Lakes. The first route they took was via the Ottawa River. (Trace this route up the Ottawa to Lake Nipissing, then by water to Lake Huron.)

In order to reach Lake Nipissing the explorers made portages, carrying their goods and canoes across land. (Indicate portage on map.)

The French took another route thru Lake Ontario up to the Niagara River and falls, where they were forced to make a long portage. (Show location of falls on map and comment.)

The teacher may describe here something of the Falls and their size, etc.

Among these early explorers was one Hennepin who made some drawings of the Falls which were very good and served to carry back to Europe a conception of their size.

After the portage around the Falls the explorers found themselves on Lake Erie where they later built the "Griffon," the first large ship above the Falls.

From these two routes into the Great Lakes, the French explored all the Great Lakes.

Continuing up Lake Erie from Niagara, they built a fort and store at Detroit. (Locate Detroit on map and continue exploration line up the Detroit River, thru Lake St. Clair, St. Clair River, thru Lake Huron along s.w. shore of Sts. of Mackinac, south along the western shore of Lake Michi-

> Three other routes to the Ohio River were taken from the present sites of Sandusky and Cleveland, Ohio, and Erie, Pennsylvania, thru the small rivers in Ohio and Pennsylvania into the Ohio River.
>
> The French explored the western routes first because the Indians were least dangerous there. Few settlements were founded because the French explorers were mostly traders and missionaries.

A comparison of the above outline with that of the film shows the extent to which the oral instruction paralleled that of the film.

(4) The testing conditions. Immediately following the instruction of both groups the children were reassembled in their history class room and were tested as follows:

First they were given two blank sheets of white paper and a copy of Goode's outline map of North America. Second, they were given the following instructions by the writer:

> "At the top of each sheet of paper and your map write your name, grade, and date. Now, we are going to ask you some questions concerning what you have just seen and heard. Answer as many as you can. You will be given time to write until you are finished. I will write the questions on the board, and will give you an opportunity to ask me questions if there is any word you cannot read. Work just as rapidly and as accurately as you can. Do not copy the questions from the board. Write your answer after each number."

gan and thru Green Bay to its head.) Other routes should be shown from Michillimackinac down eastern shore of Lake Michigan to St. Joseph and from St. Ignace along Upper Peninsula shore to St. Mary's River, up to the Rapids at Sault Ste. Marie and along the southern shore of Lake Superior to the present site of Duluth.

After exploring the Great Lakes, the French took several routes into the Ohio and Mississippi River Valley:

Route 1. From Lake Superior up the White River to the St. Croix River, down the St. Croix to the Mississippi and thence down the Mississippi.

Route 2. From the head and Green Bay up the Fox River to Lake Winnebago. Thru the Lake, on up the Fox River to a portage, across and down the Wisconsin to the Mississippi.

Besides Hennepin, La Salle was another great explorer who covered the Mississippi Valley district. They founded St. Louis, building a fort there.

Route 3. From the present site of Chicago up the south branch of the Chicago River, portage to the Des Plaines, along the Des Plaines and the Illinois to the Mississippi.

Route 4. From Lake Michigan up the St. Joseph, portage to the Kankakee, down the Kankakee, and the Illinois to the Mississippi.

Route 5. From the present site of Toledo, up the Maumee to the present site of Fort Wayne, Indiana. Portage to the Wabash, down the Wabash and the Ohio to the Mississippi.

The questions which had been prepared previous to the experiment by the writer were then written on the board. The children wrote about thirty-five minutes.

The questions used in this experiment follow, accompanied by the "correct answer" key used by the writer in scoring the papers.

Each correct answer was scored one point.

Questions four, five, twelve, fourteen, and sixteen were "map questions." These were scored as follows.

One point was given for,

Each route correctly traced.

Each portage correctly located by an X
or dashes.

Each settlement correctly located. (Detroit,
St. Louis, Quebec, Montreal.)

Questions used in University Elementary School Experiment.

1. French explorers sailed from--------to------------------.

2. In what kinds of boats did they cross the Atlantic?---.
3. After reaching America the explorers sailed up the----- river.
4. Trace on your map the first route these explorers took in reaching the Great Lakes. Number this 1.
5. Trace on your map the second route these French took in exploring the Great Lakes. Number this 2.
6. What difficulty did they have on reaching Niagara?-----
7. How did they overcome this difficulty?-----------------
8. What kind of boats did the explorers first use on the Great Lakes?--
9. Later the explorers built a ship, the "Griffon," on Lake Erie. Why did they build a boat rather than sail one up the rivers into the Lake?----------------------------
10. Give the names of two French explorers.----------------
11. What did the French build at Detroit and St. Louis?----
12. Locate on your map the important portages. Mark each with an X.
13. Why did the French explorers travel over the western rivers first?---

14. The French took four different routes in reaching the Mississippi river from the Great Lakes. Trace these routes on your map.

15. What is a portage?---------------------------------

16. Name and locate on your map the settlements founded by the French.

The sample map following represents the key used in scoring the map questions. The total possible score in the test was 38.

Accepted answers to questions used--Experiment one.

One point for each correct answer.

Point value

(1) 1. France to Quebec, or France to North America, or France to St. Lawrence River, or France to Gulf of St. Lawrence.

(1) 2. Sail boats.

(1) 3. St. Lawrence.

(1) 4. (see map).

(1) 5. (see map).

(1) 6. They had to go around the falls.

(1) 7. They carried canoes around the falls or made a portage.

(1) 8. Canoes.

(1) 9. They could not sail a large boat over the falls, or they could not carry a large boat over the portages.

(2) 10. Hennepin and La Salle (one point for each).

(2) 11. Forts and stores (one point for each).

(11) 12. (see map).

(1) 13. Indians were more friendly in the west, or Indians were more friendly there.

(8) 14. (see map). If pupils traced more than four routes correctly they were given credit for these also.

(1) 15. Land between two bodies of water over which goods are carried, or, Place where men carried canoes or goods in order to go from one body of water to another, or, Place where men carried canoes or goods in order to go around places in a river where they couldn't go.

(Note. A number said "A portage was a strip of land between two bodies of water." This was not accepted.)

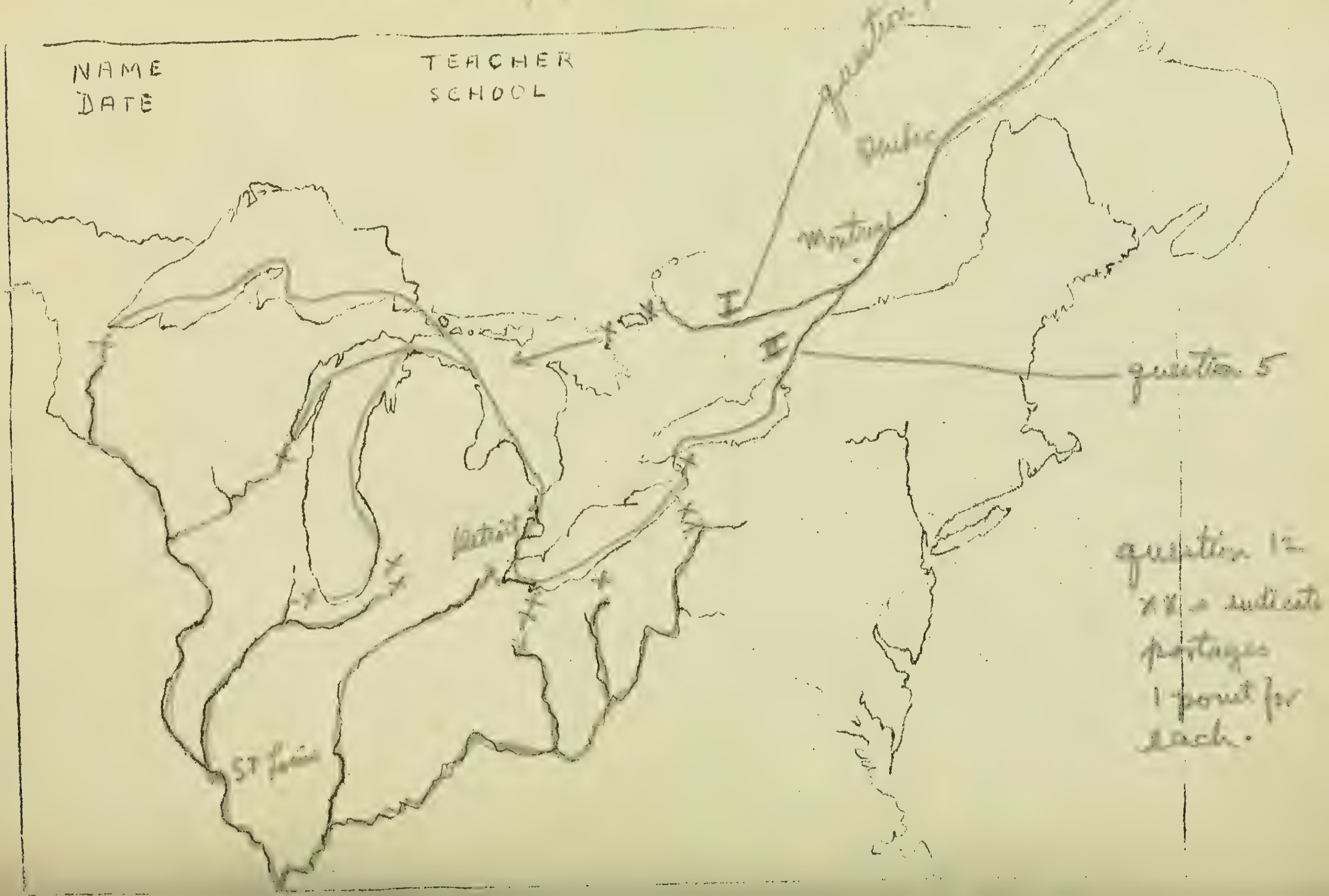
(4) 16. (see map).

(13) Total points on questions

(25) Total points on map work

(38) Total point score on test. To get the "score" add up the points made on each question.

Scoring Key for Map Questions.



question 12 —
xx = indicate portages
1 point for each.

THE RESULTS. The results of experiment one are given in table one.

Group	Number of pupils	Grade	Total ave. score	Ave. score in all but map questions	Ave. score map questions	Average I.Q.
A oral	12*	7th & 8th	16.7	9.58	7.3	106.9
B film	16		16.5	9.90	5.9	106.4

Table 1. The results of experiment one, comparing film with oral instruction at the Elementary School of the University of Chicago, May 13, 1921.

An examination of the results of this first experiment shows that the oral group made an average total score .2 of one point or 1.2 percent above that of the film group. This difference is too slight to be of much significance. However, by comparing the scores made by the two groups on the map questions a noticeable difference of 1.4 points or 23.7 percent in favor of the oral group is found. Approximately the same amount of time was spent by the teacher on the map presentation within the twelve minutes, as was used by the film during its twelve minute presentation of the same material. Had the teacher placed more emphasis then the film on the map

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*Four students in this group were absent the day of the experiment.

work, the score made by the oral group on the eleven non-map questions would have been considerably lower than the score made by the film group. The difference in score between the two groups on the non-map questions is only .32 in favor of the film group which is not large enough to account for the difference in the map question scores.

The map instruction as presented by the film was an animated line drawn on a blackboard map similar to the one used by the teacher. In_as_much as the total possible score in map work was twenty-five points, this difference of 1.4 in favor of the oral group is significant.

The score made by the two groups on the eleven non-map questions is not so significant in this experiment, because the answer to a number of the eleven questions was to be found in part or entirely in the caption in the film. Captions are reading material, hence ideas gained from the captions were transmitted thru language, not pictures. Such a comparison involves the difference of acquiring certain information thru reading as against hearing words.

Three objections can be raised concerning the reliability of the results of experiment one: first, that the film was not the best possible film to teach this

particular unit, and second, that pupils were trained to learn map work more economically under ordinary class room methods than from a film which is relatively a new method of presenting such material to children. Third, that the test did not test all of the desirable outcomes of film instruction.

While this film is perhaps not the best of films in the organization and arrangement of subject matter, the same thing could be said of the oral instruction which followed the outline of the film. One might also raise a counter question, namely; Was the method of "telling" used by the teacher the best method of teaching the oral group?

In answer to the second objection it should be understood that this group of twenty-eight children had been drilled on some of the points of learning from film in connection with another film, "The Influence of the Steamboat on United States History." Furthermore, the newness of the situation, would be a factor in favor of the film situation, since novelty, vividness, and rapid learning go hand in hand.

A discussion of the third objection would take us into the problem of the validity and value of information tests in educational measurement. It is the purpose of the writer to keep these points in mind in drawing conclusions from the results of all the experiments herein described.

CHAPTER II

Experiment 2.

A comprehensive program of research in visual education necessitated a larger laboratory than the Elementary School of the University of Chicago. A school system where moving picture instruction had been in operation was desirable for two reasons; first, the mechanics of running the experiments would be rendered easier, and second, the subjects would be familiar with the "film situation."

Thru the efforts of Dr. F. N. Freeman of the University of Chicago, permission was obtained from Superintendent Nichols and Assistant Superintendent Walker to continue the research in the South Evanston Schools. A visual education program had been in operation in Evanston for two years, and the schools were equipt with the apparatus necessary to carry forward the research in an effective manner.

Four experiments were planned on a large scale involving three schools and 282 children. A fourth school was included in the original program, but it was found to be equipt for day time projection.

Experiments two, three and four were carried out in the Central and Lincoln schools. Experiment five was taken over to the Washington school.

Inasmuch as the experiments were started near the end of the school year, it was impossible to give memory tests following the original tests. Tests the following September were out of the question since the eighth graders were promoted and scattered either in the secondary schools or elsewhere.

The success of these experiments is due largely to the cooperative efforts of Assistant Superintendent Walker and his teachers.

PROBLEM. The results of experiment one indicated that the "film method" was not as effective as the "teacher-telling method" in teaching map information. This result furnished a lead for experiment two.

It was decided to make comparisons of three methods of instruction as follows: first, to compare a presentation by the film with oral instruction during which the pupils followed the teacher's map instruction by referring to a map of North America in their geographies; second, to compare each of these forms of teaching with a combination of oral and film instruction.

DESCRIPTION OF THE EXPERIMENT. (1) Topic. The same topic was selected for experiment two that had been used in the University of Chicago Elementary School experiment, namely, "French Explorations in North America." The film by that title produced by the Society for Visual Education, Incorporated, was used for the film instruction."

(2) Subjects. Pupils of the seventh and eighth grade in the Central and Lincoln schools were selected for the experiment. These children had been tested with the Chapman Intelligence Examination[1] which is described in the Journal of Educational Research for December, 1920, pp. 777 - 786. In order to divide the children into three comparable groups, the children at each school were ranked in order of their score on the intelligence examination. Group A was formed by taking every fourth child starting with rank one; group B, by taking every fourth child starting with rank two; group C, by taking every fourth child starting with rank three. Similarly, three groups were arranged at the Lincoln school.

(This method was found later, to be inaccurate for forming three equal groups. The groups varied in average intelligence by rank as selected "A" first, "B"

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[1] J. Crosby Chapman. A Group Intelligence Examination Without Prepared Blanks. Journal of Educational Research, Vol. II. No. 5. pp. 777 - 786.

second, and "C" third. Had the groups been selected in the following manner this slight difference between the three groups would have been rectified.)

Group	A	B	C	
Rank	1	2	3	
	6	5	4	
	7	8	9 etc.	

[illegible] Presentation of the topic. Two days before the experiment detailed plans for the experiments were discussed by the writer in a meeting of the teachers participating in the research. The film was exhibited at the same time in order that the teachers giving the oral instruction would be able to parallel the film as closely as possible. Without exception the teachers agreed to do all they could to make the experiments a success.

The first half of the experiment was launched at Central school, May [illegible], 1921. The children who were to make up the personnel of each group were sent to the places assigned them in the three rooms where they were

placed in care of their teachers.

As soon as the pupils had reached their destinations the teacher in each room gave them the following instructions.

> "Today you will hear the story of the French Explorations in North America. Pay strict attention to all you hear and see, for you will be tested on what you have learned. Now, I am going to read to you for five minutes concerning these explorations. Listen while I read."

This preliminary oral discussion was the same as that used in experiment one. (See page 24)

Group A. Following the preliminary oral discussion, the teacher of group "A", which we will call the oral group, presented the story of the French Explorations for twenty-four minutes. (See page 24) During this twenty-four minute* presentation each pupil had his geography open to the same map of North America. Whenever reference was made to the map the pupils followed thru the routes taken by the French as the teacher traced them on her classroom map.

Group B. Following the five minute preliminary discussion, group "B" received twelve minutes

*The teacher timed her presentation by her watch.

oral instruction by their teacher. This instruction was the same as that given the pupils in experiment one. The pupils listened to the teacher and looked at the map used to teach the location of the routes, portages and settlements made by the French explorers. The map was a class-room map comparable to the one shown in the film. Only those routes indicated in the film were discussed during the oral presentation. The class-room maps used by groups A and B were identical copies. The teacher timed her presentation with her watch.

After the twelve minute oral discussion, group B was marched to the hall-way below where it saw the film, French Explorations. The showing of the film occupied twelve minutes. Group B joined group C in the hall-way, since group C was to see the film a second time. When the twelve minute film presentation was finished, group B returned to its room.

Group C. As soon as the teacher of group C had finished reading the five minute preliminary oral discussion, the pupils marched to the hall-way below. This lower hall was equipt with a silvered screen, drop shades and curtains so that it could be easily changed into a projection room. Folding chairs were placed in

front of the screen for the pupils and teachers. The projector used was a semi-portable, Zenith.

Film instruction and entertainments where films were used had been carried on in this school for more than two years. Hence, the film situation was not strange to the pupils; furthermore, this experience had trained them in some of the points involved in learning thru the medium of motion pictures.

Group C received twenty-four minutes of film instruction, or two showings of the film, French Explorations. As soon as the film presentation was finished, group C returned to its room.

(4) The tests. At the end of the instruction periods each pupil was given a set of mimeographed questions, a copy of a mimeographed map of North America, and the following instructions by the teachers:

> "First fill in the blank spaces at the top of each sheet. As soon as that is finished, answer as many of the questions as you can. Write your answers in the spaces provided. Use the mimeographed map for your answers to the map questions."

The testing period was supervised by the teachers and the writer.

When the pupils in groups B and C had finished their tests, the writer asked them to answer the following questions at the bottom of their question sheets;-

> "Group B." (1) What did you learn from the film that you did not learn from the teacher?
>
> (2) What did you learn from the teacher that you did not learn from the film?
>
> "Grâup C." (1) What did you learn from the second showing of the film that you did not learn from the first?

At the close of the testing period the pupils resumed their regular class work under their own teacher. The papers were collected, tied in bundles, and labled groups A.B. and C.

The test was the same as that used in experiment one. However, in experiment two the questions were mimeographed on a single sheet of paper. The outline map of North America was also mimeographed.

The papers were all scored by the writer who used the same scoring key used in experiment one.

The second half of the experiment was carried out the following day, May 14, 1921, at the Lincoln School. The experiment described above at the Central School was repeated at the Lincoln School in every detail. The same sort of projection room, a hall-way, was used at the Lincoln School. By repeating the Central School procedure, the Lincoln School half of the experiment served as a check on the results obtained at the Central School.

RESULTS. The tests given in experiment two were scored by the writer a first time. Six weeks later the scores were checked in order to secure uniform and accurate scoring.

The average scores made by each group on the map questions, the information questions, and the questions combined is shown in table 2.

Central School. May 23, 1921. 7 th and 8 th grades.

Group	Number of pupils	Average intelligence score	Score questions		Map score		Total score	
			ave. score	M.D.	average	M.D.	average	M.D.
B oral film	27	53.70	10.03	1.81	8.07	4.75	18.10	5.10
A oral	21	54.04	9.71	1.12	11.66	4.32	21.37	5.24
C film	26	51.80	9.11	1.72	5.42	3.96	14.53	4.98
	Lincoln School. May 24, 1921. 7th and 8th grades.							
B oral film	26	63.23	9.73	1.41	12.38	3.95	22.11	4.95
A oral	23	60.21	9.26	1.26	11.00	3.36	20.26	4.74
C film	25	59.56	10.60	1.39	9.56	3.59	20.16	5.01

Table 2. The average scores made by each group in experiment two.

The scores tabulated in table two show that group "A" at the Central School made the best total average score of the three groups. The oral group's total average score was 3.27 points or 18.0 % above that made by the oral-film group, "B", and 6.84 points or 47.0 % above that made by the film group, "C".

The score made by the oral group "A" on the eleven information questions was only .60 or 6.5 % higher than that made by the film group "C". The oral-film group "B" made the highest score on the eleven information questions, being .32 or 3.2 % above the oral group, and .92 or 10.0 % above the film group.

The scores made by the groups on the map questions were widely separated, as in experiment one. Here the oral group made a score over twice as large as the film group, a difference of 6.24 or 115.1 %. The oral group's score was also 3.59 or 44.4 % higher than the oral-film group. The oral-film group in turn made a score 2.65 or 48.8 % higher than the film group. The scores on the map questions are very significant when one considers the fact that the total possible score on the map work was only 25, with an average score for the entire group of 8.05.

At the Lincoln school the rank of the oral and oral-film groups is reversed from what it was in the Central school. The film group, however, ranks third in both schools in the total average score and the average map score. The reversal in rank of groups A and B may reflect the teaching ability of the teachers giving the oral instruction, a factor important enough to offset the other variable being measured.

The total average score made by the oral-film group is 1.95 or 9.6 % above that made by the film group, and 1.85 or 9.1 % above that made by the oral group. The score made by the film group on the eleven information questions was .87 or 8.9 % higher than that made by the oral-film group, and 1.34 or 14.4 % higher than that made by the oral group. It was pointed out on page above that the answers for the eleven information questions were to be found in part in the caption or language material of the film.

The scores made in the map questions were again strikingly higher for groups A and B as compared with group C. The oral-film group made an average score 2.82 or 29.5 % higher than the film group, and 1.38 or 12.5 % higher than the oral group. The oral group made a score 1.44 or 15.0 % higher than the film group. The differences

in the map scores are not so striking as the differences between the three groups in the Central school half of the experiment. However, in the Central school, Lincoln school, and the University Elementary school (see experiment one) the groups which received only film instruction made the lowest average score on the five map questions and the lowest score on the total average score.*

The method of selecting comparable groups by intelligence test scores in the Evanston experiment was faulty. (See above page 39.) This fact should be taken into consideration in the interpretation of the results of experiments two, three, and four. Furthermore, on the days the experiments were performed, several of the pupils were absent, making the number of subjects in each group different.

In order to make allowance for these differences, a procedure was followed; to throw out of the groups having a higher number of pupils those pupils whose intelligence score did not match very closely pupil for pupil the intelligence score of pupils of the smallest group, thus making the three groups equal in number and intelligence.

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*See page 51 for a qualification of this statement.

The first set of results given in table two followed procedure one. Let us examine the results of experiment two in terms of the methods of equalizing the groups.

Groups equal in number and intelligence were obtained by matching the intelligence scores of the three groups pupil by pupil, disregarding the experimental test scores. In this manner three groups of twenty-one pupils were formed in the Central school and three groups of twenty-two pupils were formed in the Lincoln school. The groups having larger numbers suffered the loss of the individuals whose test scores could not be matched.

When these groups had been formed the scores made in the test were placed in chart form opposite their names and new totals and averages computed. The results of this procedure are shown in table three.

This new tabulation of results left the rank order of the groups unchanged in the Central and Lincoln schools with one exception; the film group made higher total score than the oral group .04 or .1 % in the Lincoln school. This difference had been found to be .10 or .4 % in favor of the oral group in the original grouping given in table two. This is the only place recorded in experiments one and two where the film group made a total average score higher than an oral or oral-film group. (See page 49 .)

The difference in the ranks of the oral and oral-film groups at the Lincoln school should not be minimized. Whether it was due to the factor of the difference in teaching ability of the four teachers, the writer does not know. Certainly the difference in scores represents the effect of a factor operating other than the one measured.

A detailed examination of the responses made by the pupils to the test questions revealed some interesting facts. The work done by the pupils in the film groups on the map work lacked the unity and exactness evidenced in the other groups.

Central School. May 23, 1921. 7 th and 8 th grades.

Group	Number of pupils	Average intelligence score	Score questions		Map score		Total score	
			ave. score	M.D.	average	M.D.	average	M.D.
B oral film	21	53.98	10.14	1.53	8.28	4.92	18.42	5.13
A oral	21	5 4.04	9.71	1.12	11.66	4.32	21.37	5.24
C film	21	54.10	9.19	1.78	5.47	3.83	14.66	5.01
		Lincoln School. May 24, 1921. 7th and 8th grades.						
B oral film	22	60.25	9.72	1.30	12.22	3.51	21.94	4.99
A oral	22	60.12	9.18	1.26	11.04	3.35	20.22	4.80
C film	22	60.16	10.63	1.37	9.63	3.25	20.26	5.04

Table 3. The average score made by each group in experiment two after the groups had been paired to secure groups equal in intelligence.

In the two schools fifty-one pupils received pure film instruction on the French Explorations. Nine of these pupils misplaced St. Louis or Detroit or both, on their maps, one even going so far as to place St. Louis near the St. Lawrence river. Nine of the pupils in the two groups were mixed in the routes the French followed, even going so far in two cases as to start one route near the Hudson and Delaware rivers. Three of the fifty-one pupils made no score on the map work at all, two traced the outlines of the Great Lakes on the mimeographed maps to represent the routes taken. The remainder of the fifty-one pupils were correct in their map responses as far as they went. The highest score made by any of the fifty-one students who received the film instruction was seventeen out of a possible twenty-five.

Forty-four pupils in the two schools received oral instruction coupled with the use of the class-room map. Of these pupils, nine misplaced St. Louis, the greatest error being the placement of St. Louis at the present site of Cleveland. Others placed the city in Illinois but on the Illinois river. None of the pupils traced wrong routes, and all of them made points on their map work. The highest score made by any pupil of the oral groups on their maps was 10 out of a possible 25.

Fifty-three pupils received oral plus film instruction. Of these, three misplaced St. Louis, and one misplaced both Detroit and St. Louis. One student drew routes that were wrong. The highest score made by any of this group was 23 out of the possible total of 25.

This analysis indicates that the pure film instruction failed to fix correctly in the minds of the pupils the location of the various routes and settlements. One might raise the question, is this a result of poor attention during the presentation of the film? Does the film situation scatter the attention of the pupil? If so, is this an inherent problem in film in-

struction which must be solved by new devices in the presentation of a film which would call the attention of the pupil to the important details presented? Some answer to these questions may be found in the responses to the questions which were asked orally at the conclusion of the test period. These questions ~~above~~) were answered in writing in the space left at the bottom of the mimeographed sheet. For the film groups the question was:

1. What did you learn from the second showing of the film which you did not learn the first time?

Twenty-six pupils of the Central school replied in the following manner. Two said they learned more about the last part of the film. Four said it was "hard to get all the first time." Three said they "did not notice" certain things the first time. One said he "did not watch close" the first time. One said the second showing was not necessary. Six said the second showing helped them to remember details. Eight said "they were able to give more attention to details the second time."

Twenty-five pupils at the Lincoln school answered the same question (following the test after the

film plus film instruction) in the following manner. One said he only "got about half the first time." Two said they "had more time to watch" the second time. Four of the pupils "moved up closer to the film" in order to read the small sub-titles the second time. Three said they didn't get the "small print" the first time. Four said "nothing was made plainer" the second time. One said "that he saw places he skipped by seeing it the second time." Ten of the pupils reported that they were able to remember the details better the second time.

The responses to this question show that the pupils evidently do not give 100% attention to the showing of a film, that some device to center their attention on the important facts is needed, that the print must be large enough to be read at the farthest corner of the ordinary class-room, and that the film in continuous presentation changes to a new scene before the pupils have the chance to grasp all in the one scene before them.

Table 4. The Responses to question 1. What did you learn from the second showing of the film which you did not learn the first time?

Film groups Central and Lincoln schools. 51 pupils.

Response	Number of pupils making response
Hard to get all first time	5
Did not notice first time	3
Did not concentrate first time	1
Did not watch close first time	1
Saw places skipped first time	1
Able to give more attention to details the second time.	10
Second time helped to remember details	16
Did not get small print in film at first	3
Moved up closer the second time	4
Nothing made plainer by second showing	5
Did not answer question	2

The groups which received oral followed by film instruction were asked the following questions:

1. What did you learn from the film that you did not learn from the teacher?
2. What did you learn from the teacher that you did not learn from the film?

As in the case of the question asked the film groups, the responses were recorded at the bottom of the pupil's mimeographed test sheet. The responses are tabulated by schools (one group in each school) and by question in the following table. An examination of this table shows that the moving black line (animated) made a deep impression on the pupils. However, this did not serve to aid them in the sort of thing called for in the test, since these pupils were unable to reproduce the "moving black line" as accurately as those who received the oral or oral-film instruction. Further light on this problem may be found in the responses to question 2 where 10 of the 53 pupils thought the routes were made more clear by the teacher *because she talked while pointing to the map*. One pupil thot the film was more interesting. One thot it was "easier to see than to listen on a hot day." Three pupils said the film was too fast in comparison to the teacher. Eight thot the teacher made the portages. more clear because

she told incidents connected with the story and reasons for making the portages. Other answers of minor interest were given which are recorded in the table.

These answers are the opinion of the subjects involved in the experiments, and are therefore open to some question as to their reliability. However, the responses were all written down by the pupils themselves immediately following the experiment itself. They at least furnish some valuable leads for future experiments controlled in such a fashion that the problems raised can be solved in a scientific manner.

Table 5. The responses of pupils to question 1. What did you learn from the film that you did not learn from the teacher?

CENTRAL SCHOOL		LINCOLN SCHOOL	
Response	No. pupils Making response	Response	No. pupils Making response
Moving black line made routes more plain	4	Moving black line made routes more plain	3
Routes were made more plain by film	5	Routes were made more plain by film	6
Film was more definite	2	Niagara map more clear	1
Film more interesting and distinct	1	Great Lakes more clear	1
Portages and travel more clear	1	Portages more clear	2
Seen more plainly amount of ground covered	1	Clear at first later routes were mixed up	1
See where trips are made after done	1	Drawing by Hennepin more clear	1
Story easier to see than to listen to on hot day	1	Showed side of lake they traveled on	1
Same as seeing it	1	Pictures of portages & place of portage made portages more clear	1
(No answer to question one.)	9	Warships more clear by film	1
		Film and teacher both clear	5
		Nothing made more clear by the film	3

Table 6. The responses of pupils to question 2. What did you learn from the teacher that you did not learn from the film?

[illegible] SCHOOL		[illegible]	
Response	No. pupils Making response	Response	No. pupils Making response
Teacher talked as she pointed to map	5	Teacher talked as she pointed to map	5
Emphasis made routes clearer	3	Routes were more clear because teacher did not go so fast	1
Teacher went slow emphasized routes	1	Film was too fast to keep your mind on story	1
Teacher was more plain	1	Every thing made clearer by teacher	1
Teacher was clear because she was thorough	1	Portages and way of transportation made more clear by teacher because of reasons why, explanations and incidents	6
(did not answer question)	11		
Teacher best	3	Story part clearer by teacher made names clear	2
Clear by teacher did not understand parts of film	1	Courage and hardships	1
		Both clear	3
		No answer	4

CHAPTER III

Experiment 3.

PROBLEM. Visual aids are not limited alone to the chart, diagram or moving picture. The teaching value of still pictures, stereograph, and stereoptican slides must be investigated also. Experiment three was an attempt to compare the efficiency of the film in teaching the information contained in a unit of natural history, with (1), a stereoptican lecture, and (2), an oral presentation illustrated by two still pictures and two blackboard sketches.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The three groups in the Central and Lincoln schools, Evanston, Illinois, which were used in experiment two made up the personnel of the three groups used in experiment three. The pupils in these groups were from the seventh and eighth grades and were selected on a basis of the Chapman Intelligence examination. (See pages 39 .)

The method of instruction received by each of the three groups in experiment three was changed from that in experiment two.

(2) Topic. The film used in experiment three was "The Life History of the Monarch Butterfly," produced by the Society for Visual Education, Incorporated. This film represented an entirely different type from "French Explorations in North America," and was considered by the Society for Visual Education to be one of its best films. The time involved in showing the film was twelve minutes.

The oral instruction and stereopticon lecture followed the outline of the film as closely as possible.

(3) The presentation of the topic. The teachers selected for the oral presentations were given their instructions in conference two days before the experiment was carried out. At the same time they were shown the film in order to assure them of familiarity with the subject matter of the film. The first half of the experiment was conducted at the Central School May 20, 1921. The second half was carried out at the Lincoln School the following day.

On May 30 at one-thirty P.M. the Central School pupils were notified by superintendent Walker to form groups A, B, and C. Each group received the following instructions from their teachers, with the exception of group A.

> "To-day you will learn something of the Life History of the Monrach Butterfly. You must pay strict attention to everything you see or hear because you will all be given a test to find out what you have learned about the Life History of the Monarch Butterfly."

Group C. The oral instruction of group C followed immediately. The teacher followed the outline given below illustrating the topic with two pictures, one of the monarch the other of the larva, taken from the book entitled, "Ways of the Six-Footed", pages 48 and 50.[1] She also drew pictures of the chrysalis and spicules enlarged on the board to illustrate that phase of the topic.

The History of the Monarch Butterfly

> Perhaps no butterfly has been better named than the Monarch, for it flies fearlessly and leisurely about, confident that there in none to dispute its right. It is free from the attack of birds, because it is distasteful to them, and its bright colors proclaim that here is an insect to

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1. Anna Botsford Comstock, Ways of the Six-Footed. Ginn and Company. Boston: 1903. Pp. 48 and 50.

be left alone because of its bitter taste.

The female deposits her eggs on the milkweed. These eggs hatch into caterpillars or larva which have four feelers, two at each end of the body. The milkweed leaves furnish food and shelter to the larva. When the larva or caterpillar is full grown it is about two inches long and spins a small silk button. This button is located so that the larva can hang by its tail from the leaf after it has fastened the silk button to the leaf. After hanging several hours the feelers at each end of the larva shrivel up and only one white stripe is left in the coloring of its skin.

Now it is ready to shed its skin. First it wriggles and wiggles and works its legs loose inside of the old skin. Then the old skin bursts and the larva works loose finally getting the skin clear off by wiggling and kicking and pushing its way out.

The larva emerges from the old skin as a beautiful pale green chrysalis shorter than the larva, and at first sight seemingly without head or limbs. The chrysalis is smooth, rounded at one end and tapering at the other extremity. On close examination, however, there may be found traces of a head, tongue, antennae or feelers, wings, and legs closely pressed to the body inside the skin of the crysalis.

The chrysalis remains at rest, taking no food, until two days have passed. Then it turns brown and swells, bursting its skin over the back and from the opening the head, body, and wings of the new Monarch butterfly springs.

The butterfly is very moist and weak at first. Its wings are small and shriveled. Soon the butterfly climbs to a leaf to rest where the damp wings expand and dry.

> After several hours of exercising and gaining strength, the butterfly is able to leave the leaf and fly away into its first adventure among its fellows.
>
> The male monarch butterfly differs from the female in its markings mainly by the small scent spot at the tip of its wings. This scent spot is used to attract the female.
>
> The Monarch butterfly like other butterflies has its wings covered with small scales which overlap each other like the scales of fishes. To the eye these scales appear as a powder, but under the microscope are shown to be shaped something like a grain of corn, and flat.

Group B passed to the hall-way below, which had been darkened, and received the presentation of the stereoptican lecture. The lecturer followed the outline shown on pages 63 , making reference to the slides by pointing to various portions of the picture thrown on the screen.

The slides used were eight in number which duplicated the film very closely. The slides were loaned to the writer by Mr. Yeger of the School of Education, University of Chicago, and illustrated the complete cycle of the life history of the Monarch butterfly.

The presentation of the stereoptican lecture at the Central school was interrupted by parents who were visiting the school that afternoon. They came in

the hall chatting and talking so that the group's attention was visibly disturbed. This was unfortunate, and the results of group B's performance in the test reflects this factor.

As soon as the twelve minute lecture was finished, the children returned to their room and took the mimeographed test.

Group A received twelve minutes of instruction on the Life History of the Monarch Butterfly thru one showing of the film by that title. They followed group B to the hall and received their instructions there before seeing the film. The presentation of the film did not meet with the same disturbance noted during the stereoptican lecture.

The outline of the film by captions is as follows.

C.M.Dietz
Ed. by C.J.P.
Oct. 29,1920

ANIMAL FILMS

The Life History of the Monarch Butterfly

Published by Society for Visual
Education, Inc. Chicago

The object of this picture is to familiarize the pupil with the life processes of many butterflies in general, and of this one in particular, and to show how even such a simple form of animal life must adapt itself to environment in order that it may survive.

(The illustrations inserted under each caption are copied direct from the film and illustrate that phase of the story.)

Outline of contents
(Titles underlined)

Picture of the milkweed plant is shown

The Monarch larva gets its shelter and food from the common milkweed

Picture of larva on leaf and larva eating.

Larva on leaf.
This picture was
paralleled with a slide.

Larva eating

It has sensitive "feelers" at each end

Picture showing sense organs

When full grown, the larva spins a silk button from which to hang by its tail

Picture showing larva spinning pad, turning and fastening tail, letting go leaf.

Larva letting go leaf

After hanging several hours one white stripe remains, and the antennae shrivel

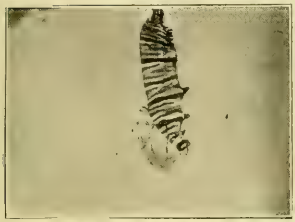
White stripe and shrivelled antennae pointed out

Next, it works its legs loose inside the old skin

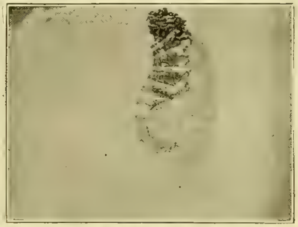
Legs being worked loose

Then the larva bursts its old skin and works it off, emerging as a beautiful pale green chrysalis

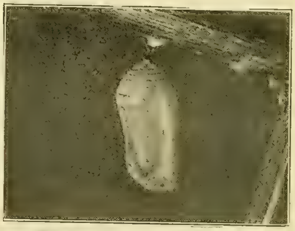
Larva swells and skin splits.
Shedding of the skin.
Chrysalis shaping itself.



Larva swells and skin splits.
Paralleled by slide



Shedding of the skin



The chrysalis
Paralleled by slide

The larva's bright ring has become a band of golden spots on the chrysalis

Same indicated by pointer

Wings tightly folded in the chrysalis

Shape of wing shows thru side of chrysalis

Legs, antennae and probosis are folded between the wings

The position of these is seen in outline

The perfect chrysalis

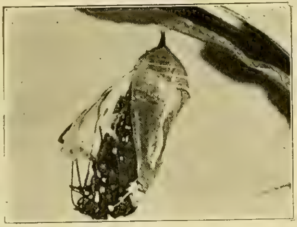
Same (See illustration above)

The chrysalis turns brown as the outlines of the butterfly become visible

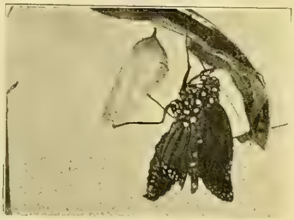
Brown chrysalis

The butterfly breaks out of the chrysalis but is very weak at first

Bursting chrysalis
Clinging to empty shell
(Note the shape and action of feet and legs)



Bursting chrysalis
This was paralleled in the slide



Clinging to empty shell.

After a few minutes rest the butterfly climbs to a leaf where the damp crumpled wings expand and dry

Butterfly seen clinging to leaf; wings
appear crumpled; wings seen expanding.
(See illustration above)

Strength to fly comes thru several hours exercise

Exercising wings

The perfect male and female

Same

The male's scent spot is the main distinguishing mark

Same

Magnified section of wing showing spicules

Same

Spicule highly magnified

Same

THE TESTS. Immediately following each presentation the groups were tested by a mimeographed set of questions. These questions were designed to bring out the story of the life history of the Monarch butterfly in each of its phases. Questions 7&15 called for either a descriptive account or drawing to illustrate the object under consideration. The correct answers to all the questions were set down and the papers were scored according to these answers by the writer. A copy of the test and key of correct answers used in scoring the papers follow.

Name__________________ Grade__________ Teacher_________ Date_______

1. What is a larva?____

2. Where does the monarch larva get its food?___________________

3. The four feelers of the larva are located____________________

4. When full grown the larva hangs by its tail from a leaf. How does it do this?____

5. After hanging several hours by its tail what happens to the feelers and white stripes of the larva?____________________

6. Tell what happens next to the larva.________________________

7. Describe or draw a picture of a chrysalis____________________
____

8. The skin of the chrysalis is transparent. What can you see inside of it?____

9. Tell what happens next to the chrysalis_____________________

10. Why does the butterfly climb up on a leaf to rest after what you have just described above?__________________________

11. How long must the butterfly wait before it is able to fly?__

12. What does it do while waiting?______________________________

13. What distinguishes the male monarch from the female?________

14. What covers the wing of the butterfly?_____________________

15. Draw a picture to show what this looks like under the microscope.

16. Is there anything about the story of the monarch butterfly that you do not understand? Why? ____________________
____

Correct answers to questions in test for experiment three.

One point for each answer correct.

oint value

(1) 1. The worm hatched from the egg of the monarch butterfly, or the first stage of the monarch butterfly. (Many of the pupils said it was "a large worm". This answer was not accepted.)

(1) 2. From the milkweed.

(1) 3. Two at each end of the body of the larva.

(1) 4. By spinning a silk button on the leaf and fastening itself to it.

(1) 5. They shrivel up and disappear all but one white stripe.

(1) 6. It splits its skin and the chrysalis comes out.

(1) 7. A chrysalis is the second stage of the development of the monarch butterfly. It is pear shaped, or

(1) 8. Legs, antennae, wings tightly folded together.

(3) 9. It turns brown, splits its skin, and the butterfly breaks out of the chrysalis. (One point for each step given correctly.)

(1) 10. To dry its wings.

(1) 11. Several hours.

(1) 12. Exercises its wings.

(1) 13. Small scent spot on tip of wing.

(1) 14. Spicules or scales.

(1) 15. Like a grain of corn Like shingles on a house

16. (The purpose of question 16 was to furnish further leads for future experiments.)

(17) Total possible score. To get the "score" add up the points made on each question.

THE RESULTS. After the scores were tabulated the average and median score for each group was computed and recorded in the following table.

Central School

Group	No. Pupils	Total average score	Mean Devia	Intelligence Score	Median
Oral C	26	12.34	2.11	51.44	15.00
Stereo. B	27	13.19	1.48	52.74	14.25
Film A	21	13.47	1.88	53.90	14.11

Lincoln School

Group	No. Pupils	Total average score	Mean Devia	Intelligence Score	Median
Oral C	26	14.50	1.44	62.50	15.20
Stereo. A	21	13.85	1.21	56.57	14.75
Film B	27	13.57	1.18	64.59	14.21

Table 7. The results of experiment three with the film "The Life History of the Monarch Butterfly" conducted at Evanston.

An examination of the figures in the table above shows that the film group in the Central school made slightly the best score of the three groups, being .28 points or 2.1 percent above the average of the slide group and 1.13 points or 9.1 percent above the average of the oral group. However, if the median scores are compared, one finds that the slide group is .13 points or .9 percent above the film group which is in turn 1.12 points or 9.6 percent above the oral group. These figures are not so significant because the reliability of the score made by the slide group may be brought into question. During the presentation of the stereopticon lecture there was considerable confusion in the hall where the experiments were being conducted. Visitors at the school disturbed the children to the extent that seventeen of the twenty seven pupils in the slide group wrote on their papers that they could not hear all that was said on account of the noise in the hall. This statement was made in response to the question, "Was there anything about the story of the Life History of the Monarch Butterfly that you did not understand"?

The difference between the score made by the oral group and the film group is in part offset in view of the difference in intelligence of the two groups. However, a difference of 1.18 points or 9.1 percent advantage for the film group is significant in view of the fact that

seventeen points was the highest possible score that could be made in the test.

The results in the Lincoln school do not check with the results obtained at the Central school. Three factors may explain this discrepancy. First, no confusion was present during the stereoptican lecture at the Lincoln school as at the Central school. Second, different teachers taught the oral groups. Third, the rank order of the three groups by average intelligence score in the two schools was not the same.

By average score the oral group was superior to the slide group .45 points or 3.2 percent which in turn made a better score than the film group by .48 points or 3.5 percent. By medain scores the oral group was first, the slide second, and the film third, by rank. However, by average intelligence scores the film group ranked first, the oral second, and the slide third with a difference of 6.02 points between the film and slide groups. In view of this difference in the average intelligence scores of the three groups, the superiority of the oral and slide groups is more marked.

In order to equalize the groups in experiment three, the procedure of matching the intelligence scores of the pupils in the smallest group with those in the larger groups was carried out the same as in experiment two.

Scores of pupils in the larger groups which were not used in this equalizing process were thrown out. This gave three groups equal in number and approximately equal in intelligence. The scores made by the pupils in the "Butterfly test were then tabulated and new totals, averages and medians were computed with the result shown in table eight.

Central School

Group	No. Pupils	Total average score	Median	Average Intelligence Score
Oral C	21	12.52	12.67	55.95
Stereopticon B	21	14.14	14.49	55.95
Film A	21	14.47	14.12	55.90

Lincoln School

Group	No. Pupils	Total average score	Median	Average Intelligence Score
Oral C	20	14.65	15.00	60.60
Stereopticon A	20	13.90	13.00	60.55
Film B	20	13.55	14.20	60.65

Table 8. Result of equalizing the groups as to number and average intelligence score. Experiment three.

A comparison of tables 7 and 8 shows that the relationship in terms of rank between the scores made by the three groups in the Central school remains the same. In the Lincoln school the relationship in terms of rank of the three groups by averages is the same, but the oral and stereoptican groups are tied with a median of 15.00 for rank one. The results of this experiment are either so contradictory in the two schools or so close together that the most significant fact seems to be that the stereoptican group made a slightly higher median score than the film group in both schools. This difference in favor of the stereoptican group might have been more marked in the Central school had the stereoptican lecture gone thru undisturbed.

CHAPTER IV

Experiment 4.

PROBLEM. The materials of visual instruction should not only be compared to determine the relative value of each to the teacher but combinations of these materials should also be compared under laboratory conditions.

Experiment four represents an attempt to compare the efficiency of three forms of presentation in transmitting to pupils the information contained in a selected unit of subject matter. These forms of presentation were first, the moving picture film, second the stereoptican slide in combination with the moving picture film and third the moving picture in combination with material read to the pupils.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The three groups of pupils in the Central and Lincoln schools, Evanston, Illinois which were used in experiments two and three acted as subjects in experiment four. These one hundred and sixty pupils of the seventh and eighth grades were arranged in comparable groups on a basis of their scores made in the Chapman Intelligence

examination. (See pages 39+40) The method of instruction received by each of the three groups was changed from that in experiment two.

(2) Topic. Another history film was selected for experiment four entitled, "The Panama Canal and Its Historical Significance," produced by the Society for Visual Education, Incorporated. The film was scenic in nature containing few action pictures. A number of maps were shown with sub-titles to indicate the location of the canal and other items of information. The outline of the film indicates the subject matter presented by the film.

In order to duplicate the film with a stereopticon lecture the writer rented twenty-five slides from the McIntosh Slide Company located at 30 Randolph Street, Chicago, Illinois. These slides were selected with great care out of three hundred or more slides for the purpose of duplicating as closely as possible the different phases of the topic illustrated by the film.

The printed matter which was read to the pupils in the oral-film groups was an essay on the topic sent with the film by the Society for Visual Education.

(5) The presentation of the topic. The teachers who were to take part in experiment four received their instructions in conference with the writer three days before the experiment was conducted at the Central School June 3, 1921. At the same conference they were shown the film in order to give them familiarity with the subject matter presented therein.

On June third the Central school pupils in groups A, B, and C were assembled in their respective class rooms at one-thirty P. M. Each group received the following instructions from their teachers.

> "Today you will learn something of the history and significance of the Panama Canal. You must pay strict attention to everything you see or hear because you will all be given a test to find out what you have learned about the Panama Canal."

Group C. The printed material was read to group C immediately following the above instructions. This material was the essay on the Panama Canal accompanying the outline of the film sent out by the Society for Visual Education. The teacher reading this material took fifteen minutes to finish it. It will be seen from the copy of the printed matter given below that the terms used in the discussion are above the heads of seventh and

eighth graders. This discussion while providing a background for the film did not duplicate the outline of the film. Hence, some of the information gained by the pupils from the essay could not be used in answering the questions in the test.

THE PANAMA CANAL

DISCUSSION

Among the numerous Spanish explorers in the seas of the western hemisphere trying to find a route to Asia, was Columbus. After landing at Limon Bay, named by him the Bay of Ships, he went far enough inland to find the Chagres River, which he called the River of Crocodiles, because of the many alligators there which resembled the crocodiles of his country. Had he followed on to the Pacific he might have been the first explorer of the route of the Panama Canal. But, thinking he had found Asia, he sailed home satisfied. During the years that followed, realizing that this continent was not Asia, other explorers, seeking a route to Asia thru the American continent shorter than this one around Africa, tried every stream from Labrador to Brazil. Near the southern point of South America, Magellan found the strait that bears his name.

There is a queer goose-neck turn in the Isthmus of Panama which makes it possible in some places to see the sun rise in the Pacific, and set in the Atlantic. Balboa, a Spaniard, was the first explorer to cross the isthmus then called Darien. While he was Governor of the colony there he started across the isthmus with Indian aid, by the easiest route averaging two miles a day, about twenty three days in all. From a tree top on September 25, 1513, he sighted the great sea beyond, calling it the Southern Sea. Later, again with Indian aid, he carried four ships, piece by piece, thru the jungle and rebuilt them on the Pacific side, preparing to search for reported hoards of gold. But he was beheaded by the jealous newly appointed governor, and so never made a Pacific voyage.

Saavedra, Spanish engineer, suggested cutting a ship canal thru the isthmus in 1517, about 400 years before one was actually completed. He made plans, but decided they were impossible. A Post Road, however, was established between the city of Panama and Porto Bello--near Colon, Spanish abbreviation for Columbus. Gold from Peruvian mines was brot over this road by pack loads in relays to Las Cruces and by

boat on the Chagres River to ships bound for Spain. Then for a century or more there was no traffic until in 1849 gold was discovered in California. Prospecters preferred to go by the shortest water route, since the desert and mountains had taken so many lives. This isthmian route became so popular that the Panama Railroad was built in 1855 from Colon to Panama City. It cost five years of terrible effort, $7,000,000 in money, and 6,000 lives by disease and other mishaps of the jungle. In the ten following years it earned $11,000,000 and has been invaluable in building the canal.

Under the French Government De Lesseps, who built the Suez, attempted to make a canal thru Panama, but he lost 25,000 men, spent $260,000,000, then quit.

After the Spanish War and the sixty eight day trip of the battle-ship Oregon from San Francisco around the Horn to Key West the U. S. Government surveyed a route thru Lake Nicaragua, but later bought the rights and property of the French Panama Canal Co. for $40,000,000. Columbia's representative in Washington made an agreement for canal terms, but the Columbian Congress rejected it. Panamans, disappointed by this rejection, declared themselves a republic independent of Columbia, and were acknowledged by the United States. A treaty was then made with the new republic--December 18, 1903-- and which under the United States obtained a canal zone ten miles wide,- five miles on either side of the canal property. In this zone, United States has complete control of police and judicial matters, and of sanitary measures. In addition to the coast line of the zone, the islands in Panama Bay were ceded for defense of the canal. But the cities of Panama and Colon remain except that the United States controls quarantine and sanitation in both harbors. In return the United States paid $10,000,000 in cash to Panama and will pay $250,000 yearly after 1912.

President Roosevelt appointed seven experts--the Isthmian Canal Commission--in charge of the building of the canal. Three great tasks confronted them. First, the sanitary improvement of the canal zone and the provisions for the health and comfort of the army of employes and their families; second, the cutting of the Culebra Pass; and third, controlling the Chagres River.

The war on mosquitoes was the greatest ever waged. In 1906 there were 3200 barrels of oil poured on the waters to smother the wigglers. There are about fifty varieties in the zone, but only three are dangerous. For examples, the stegomyia carries yellow fever, the anopholes carries malaria. The housefly, carrying typhoid germ on its legs, was also a dangerous pest. All garbage was burned, reservoirs were built, and old cisterns were filled up. In the first year of American construction work there were only three deaths from yellow fever, whereas formerly there had been three hundred annually. In nine years Gen. Wm. C. Gorgas and his sanitary force practically freed the Isthmus from malaria, yellow fever and dysentery. When he retired the death rate among the Canal workers had been reduced to only five a year from each thousand people.

There were 40,000 workers in the canal zone, Including Jamaican negroes, Spanish peasants to prod the lazy negroes, Italians, Greeks, Armenians, Turks, coolies from India and 6,000 American engineers and foremen. Jackson Smith, chief of the Dep't of Labor and Quarters "by organizing a small band of experts for taking care of human beings--for each must have the food of his 'home'to be happy---" was very successful. Food was brought from New York or New Orleans by cold storage ships, then by refrigerator cars across the isthmus. Everything belonged to the government; doctors and dentists were supplied for all. Recreation, club houses, women's clubs, churches, music and schools were provided. Even Boy Scouts were organized, with real jungle in which to scout.

In cutting the Culebra--now called Galliard for the man who directed the work--more dynamite was used in blasting in a week than the rest of the world used in a month. All the materials excavated from the canal would build 5840 monuments the size of Washington Monument--55 feet each way at the base, 555 feet high. Placed together these would cover 457 acres. Or the amount of excavation in the zone would dig a ditch 10 feet deep, 55 ft. wide from New York to San Francisco. With their huge concrete plant the Americans did more in five years than the Egyptians with their millions of slaves did in 100 years.

Every lock contains more cement than the largest pyramid, and there are six locks at Gatun alone. The concrete used would build 500 shafts the size of Washington Monument, or build a wall 8 feet thick and 12 feet high around the entire state of Delaware, or 133 miles in length.

The benefits of this $400,000,000 project are two fold; convenience to commerce and aid to military affairs. Cost and time are reduced in shipping from coast to coast. A 6,000 ton steamer loaded with fruit and making 12 knots does the trip from New York to Los Angeles in 18 days, making 16 knots, in 14 days. Whereas the rail freight across continent takes from 20 to 60 days. From Callao, Peru, to New York is 9,762 miles via St. of Magellan, 3,359 via Panama; to New Orleans, 10,102 miles as compared with 2,708 miles via canal. New York to China via Suez is 13,844 miles; via Panama, 8,138 miles.

The 'Penrith Castle' from Galveston to Yokohoma saved 22 days at sea at an average cost of operating expenses of $230 a day, a saving of $5,060. The "Arizonan" of the American Hawaiian Co., going from the Atlantic to the Pacific via Panama saves 26.8 days at $450 a day, a saving of $11,700. The tolls of $7,891.20 leaves a net saving of $3,809.80 per voyage.

The opening of the canal increased the effectiveness of the navy by reducing the distances between points in the Atlantic and points in the Pacific, and by reducing the problem of coaling on a coast to coast cruise. It has made possible the concentration of a fleet at either entrance of the canal, which, with a cruising speed of 15 knots could reach the center of the Pacific coast in 9 days, and the center of the Atlantic coast in 5 days.

The route has its initial station in Linton Bay on the Atlantic side, runs almost due south 7 miles to Gatun Dam, an artificial ridge 1 1-2 miles long, the construction of which is considered one of the most difficult features of the canal. Thru Gatun Lake a channel passes for 24 miles thru Galliard Cut for 7.97 miles to Pedro Miguel dam and Lock, 1400 feet long, thru Miraflores Lake for 1.14 miles, the dam for 2700 feet, and the locks for 500 feet; lastly thru the Panama waterway into the Pacific.

These locks are in three sets. The set at Gatun consists of three pairs of locks and acquire an elevation of 85 feet above the sea; the pair of Pedro Miguel gives a lift of 30 1-3 feet; and the set of two pairs at Miraflores Lake takes care of the remaining 54 2-3 feet. There was not enough rock foundation at the Pacific end for three pairs of locks as at Gatun, so one was made at Pedro Miguel and two at Miraflores, a few miles away.

Work on the canal was begun May 4, 1904, and it was open to commerce, August 15, 1914, just after the great World War began. But, in spite of the falling off in commerce due to that conflict, it became a paying investment from the standpoint of actual earnings before the armistice was signed. Also, one must remember that instead of a route thru a jungle of horrors and disease, the zone is now a place where the death rate is less than that of some of our large cities.

When the teacher had finished reading the essay on the Panama Canal, group C marched to the lower hall-way and received fifteen minutes of film instruction. (See page 42 for a description of the projection room.)

Group B. During the time the essay was being read to group C, group B was in the hall-way listening to the stereopticon lecture on the, Historical Significance of the Panama Canal. This lecture followed the outline of the film and attempted to duplicate the film as closely as possible. It is obvious that there were certain portions of the film which could not be duplicated exactly by means of the available slides used in this experiment.

(See page 83 for a description of how the slides were selected.) This is especially true of the few rapid scenes shown by the film of the Panama Canal and its surrounding territory taken from an areoplane. The proper method of making comparisons between the film and slide methods of instruction would be to make stereoptican slides direct from the film.

The writer attempted to have this done for experiment four but was not successful in obtaining permission to duplicate the film in slides from the owners of the film.

Following the stereoptican lecture group B received fifteen minutes instruction from one showing of the film.

Group A. Group A waited for fifteen minutes in its room before beginning its instruction, in order that the hall-way could be used for the stersoptican lecture. The teacher in charge of the group kept the pupils occupied with their lessons until it was time for them to pass to the projection room.

The group, simultaneously with groups B and C, saw one showing of the film. Groups B and C having finished their instruction marched back to their rooms and took

the test while group A remained for a second showing of the film.

The outline of the film by captions with a brief description of each scene follows.

SCHOOL FILMS

THE PANAMA CANAL
And Its Historical Significance.

Published by

Society for Visual Education, Inc.

Chicago, Illinois.

This reel is included in the Economic History series to show the importance of the Panama Canal project. It traces the desires of four hundred years before its final accomplishment. Especially does it show the thorough, systematic, and successful efforts of the Americans, who finally accomplished the feat. It shows what sanitation has done for Panama. And it makes clear the advantage to the entire world of shortening the great commercial routes, as well as the local value to the United States.

Outline of Contents
(Titles underlined)

A projection of the world is shown with the western hemisphere in the center; location of Panama shown

Spanish explorations and conquests in the 16 th century were incomplete because ships could not pass thru Panama.

Voyages of Ponce de Leon, Cortes, and Magellan are indicated.

Balboa, struggling across the Isthmus on foot, discovered the Pacific in 1513

Route from Spain to Panama and path across the isthmus indicated.

Cortez urged the King to build Panama Canal, to enable Spain to conquor the entire American Pacific coast

On a map of the Western hemisphere the relation between the Panama Canal location and the coasts of North and of the South on the Pacific side are shown

When the United States acquired California (1848) a ship passage through Central America became desirable.

Route from New York to SanFrancisco via Cape Horn shown

Many 'Forty Niners' walked across the Isthmus enroute to the California Gold Fields

Route via the Isthmus of Panama, which saved 8500 miles is shown

If the Panama Canal had existed 1850 to 1865, it would have influenced the conflict between the North and the South

On a map of the U.S., West Indies, and Central America the relative locations of the northern and southern factions, the sparsely settled areas of the Rocky Mts. plateau and Pacific section, and the isthmus of Panama are shown.

Through a Canal here southern planters seeking fresh land could have settled California.

Route indicated from New Orleans to California via a suppositious canal on the isthmus

Control of such a canal by Confederates would have made the southern blocade more difficult

Several routes possible through a canal here are shown leading from the Pacific to Gulf Points.

Seeking shorter trade routes, the French Panama Company began canal construction

On a map of Central America, the states are indicated and named; a proposed canal route is indicated.

Engineering troubles and yellow fever caused the French to abandon work in 1889.

Scene Shown

The Spanish American War emphasized the need for the Panama Canal

Cuba, Porto Rico, and San Francisco, where the Battleship Oregon was stationed in 1898 are located, and its route around Cape Horn to Key West indicated; route via a canal through the isthmus indicated as taking ¼ the time.

The Old Oregon

Shown

In 1903 Panama seceded from Columbia and granted canal zone to the United States

The Republic of Panama shown on map and Canal Zone indicated.

President Roosevelt pushed the canal construction energetically

Portrait shown
Scenes of construction shown.

Major General George W. Goethals, chief engineer and governor of the Canal zone during construction

Portrait shown.

Surgeon General Wm. C. Gorgas made construction work possible by eradicating yellow fever in the Canal zone.

Portrait shown

The first loaded freighter passed the Panama Canal, August 15, 1914

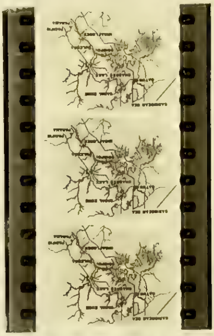
Scenes shown of ship in canal; route from London shown, around Cape Horn to Australia, then via Panama Canal saving 4000 miles.

Panama Canal aids inter-ocean movements of our fleet

War ship shown going through Canal. (Courtesy of U.S. Navy)

The details of the Canal Zone

Detailed map of canal zone on the isthmus shown, and main points indicated: Caribbean Sea, Gatun, Chagres Lake, Obispo, Culebra, Miraflores, Panama, and Pacific Ocean.



This is a print of the Canal Zone map used in the film. The print is made direct from the "positive" film.

The following scenes are described by the titles. All are shown by courtesy of the U.S. Navy.

Scenes along the Panama Railway

Bird's eye view of jungle through which canal was built

Aerial scenes of Panama City under United States sanitary regulations

A group of United States destroyers anchored at the entrance of the Canal

The great dry dock and its repair station

TITLES OF SLIDES USED IN STEREOPTICAN LECTURE ON PANAMA CANAL

1. Map of world.
2. Water front Colon.
3. Fumigating Brigade.
4. Canal Channel north from point 1.
5. Pedro Miguel Locks.
6. East Chamber Locks.
7. First boat in canal.
8. Gatun Lock.
9. Map North America.
10. French Dredges.
11. Battleship Missouri in lock.
12. Gatun Upper Lock.
13. Culebra Cut. Break West Bank.
14. Artificial Lake.
15. Jungle.
16. Map of Panama railroad.
17. French Engines.
18. Map of canal (relief).
19. Battleship Oregon.
20. Battleship Minnesota.
21. General Goethals.
22. Gatun Spillway.
23. On bank of Culebra.
24. Culebra cut with water.
25. Gatun dam and lake.

The time spent on each slide was approximately 36 seconds. Twenty-five slides were shown, with comments, in 15 minutes.

(4) Tests. The tests were given to the groups as soon as the unit of instruction in each group had been completed. Before the pupils started to take the test the following instructions were given them by their teacher.

> "You have two sheets of questions today. Write your name, the date, and your teachers name at the top of each sheet. As soon as you have done this start to answer the questions by filling in the blank spaces. Question twelve is a map question. Draw your map on the back of your first sheet. Answer just as many questions as you can. All will be given time to finish."

The papers were collected when the pupils had finished and tied in bundles by groups. All the papers were scored by the writer according to a correct answer key. In order to secure accuracy and uniformity in the score, the papers were all checked a second time eight weeks after the "first scoring".

The sixteen mimeographed questions used in experiment four and the correct answer key follows.

1. Why were the explorations made by Ponce de Leon, Cortiz and Magellan in Central America, incomplete? ____________________

2. ____________ discovered the Pacific in 1513 by sailing from ____________ to ____________ and crossing ________ on foot.

3. Why did a ship passage through Central America become desirable when the United States acquired California in 1846? __________

____

____

4. How did many of the gold miners save time when reaching the California gold fields in 1849? ____________________________

____

5. If the Panama Canal had existed in 1860 to 1865, how might it have influenced the conflict between the North and South? ____

____

6. Who started to build a canal first? ________________________

7. Why did this company abandon work? ________________________

8. What event in the Spanish American war emphasized the need of the Panama Canal? ____________________________________

9. What three great Americans pushed through the Canal construction? What part did each play in the work? ____________________

____

10. When did the first freight ship pass through the Canal? ________

11. How much distance does the Canal save a ship going from London to Australia? ____________________________________

12. On the back of this sheet draw a map of the Panama Canal, indicating the Caribbean Sea, Panama City, Mireflores, Gatun, Culibra Cut, Chagres Lake and the Pacific Ocean.

13. What is a lock in a canal, and how does it operate? ______________

____

14. Why should the United States build forts, and station war ships at the canal? ____

15. What is the Culibra Cut? ________________________________

____

16. What trouble do they have there? ___________________________

____

____

(Note. The following misspellings should be noted in the test due to improper copying of the copy for the stencil: "Cortis", "Mireflores", "Chagres", and "Culibra".)

Correct answer key. One point for each correct answer. In question 12 one point was given for the correct location of the items listed. The point value of each question is indicated in brackets.

(1) 1. Because they did not discover the Pacific ocean, or
Because they did not cross the isthmus of Panama.

(1) 2. Balboa Spain Panama the isthmus, or
Balboa Spain America Panama, or
Balboa Europe Central America Panama.

(1) 3. To reduce the length of the shipping route from New York to San Francisco, or To save time going from New York to San Francisco by water.

(1) 4. Walked across the Isthmus of Panama, or
Walked across Panama, or
Crossed Panama (or isthmus of Panama) on foot.

(1) 5. A blockade of the South would have been more difficult.

(1) 6. The French.

(1) 7. Engineering trouble and yellow fever, or
Sickness and engineering trouble.

(1) 8. The trip of the Oregon, or
The trip of the Oregon around South America.

(6) 9. President Roosevelt, pushed work at home
George W. Goethals, engineer (or governor)
Wm. C. Gorgas, eradicated sickness (or yellow fever).
(One point for each man named and one point for the part each played in the work.)

(1) 10. August 15, 1914, or 1914.

(1) 11. 4000 miles.

(7) 12. (One point for each located correctly.)

(2) 13. "stair steps" of the canal, or Place in canal where ships go up or down hill, or Compartments in canal where water is lowered and raised to lower or raise a ship.

Water flows into lock from above raising level of water and with it the ship to level of lock above.
(One point for each.)

(1) 14. To protect the canal, or
To guard the canal from enemies.

(1) 15. A place where canal was cut thru a mountain, or
A cut thru a mountain, or A cut thru a large hill.

(1) 16. Slides of land.

---

(28) Total possible score

The day following the Central School half of the experiment the same procedure described above was duplicated in the Lincoln School. This enabled the results of the work in the two schools to be checked one against the other as has been done in experiments two and three.

RESULTS. The average scores made by the six groups in the two fold test are shown in table nine.

Central School

Group	No. of pupils	Total score average	Mean Deviation. Total score	Score map questions	Mean Deviation. Map questions	Intelligence score average
D. oral & film	23	8.04	2.90	.35	.59	50.56
B. slide & film	22	12.45	4.58	1.68	.60	54.00
A. film	22	13.77	3.41	1.27	1.45	54.86

Lincoln School

Group	No. of pupils	Total score average	Mean Deviation. Total score	Score Map questions	Mean Deviation. Map questions	Intelligence score average
A. oral & film	22	10.72	3.71	.86	1.09	59.77
D. slide & film	26	15.42	2.94	2.77	.97	61.50
B. film	23	12.82	2.42	1.04	1.44	63.95

Table 9. The average scores made by the six groups in experiment four, Evanston, Illinois.

The low total scores made by the oral-film group in both schools is of little comparative significance since the essay proved to be above the comprehension of the seventh and eighth grade pupils. This result shows, however, that the printed material accompanying a film should be as carefully prepared as the film itself if it is to properly serve the purpose for which it was intended.

The oral-film groups had one half as much instruction on the map work as the other two groups, hence, a comparison between the map scores made by the three groups would not be legitimate. Let us compare, then, the scores made on the test by the film group and the slide-film group in the two schools.

The slide-film group at the Central school made a lower total score than the film group, a difference of 1.32 points or 10.6 percent while the film group made a score .4 or 3.2 percent lower on the map question than the slide-film group. (Since the total possible score on the map question was seven points this difference of .41 or 3.2 percent is greater than it appears to be at first glance.)

At the Lincoln school the slide-film group made a total average score 2.60 points or 20.2 percent above that of the film group and 1.75points or 16.6 percent above that of the film group on the map

question. The latter score is over twice as large as the score made by the film group. Here again, as in experiments one and two we find pure film instruction is not as effective in teaching map work as some combination of oral and visual material.

The film groups had the highest intelligence scores in both schools. This was due to the method of selecting the groups. (See page 39). Hence, the groups were equalized by following the procedure of matching intelligence scores pupil for pupil in the three groups and the results of experiment four were retabulated as shown in table ten.

Central School

Group	Number pupils	Total score average	Map score average	Intelligence average score
C. oral & film	21	8.47	.38	52.14*
B. slide & film	21	12.71	1.76	54.90
A. film	21	13.66	1.33	54.86

Lincoln School

Group	Number pupils	Total score average	Map score average	Intelligence average score
A. oral & film	20	10.75	.95	62.60
C. slide & film	20	16.45	2.80	62.20
B. film	20	13.20	1.00	62.50

Table 10. The results of experiment four after the groups were matched in intelligence and number. (For a description of the method used see pages 49-50.

An examination of table **ten** shows that the relationship, in terms of rank by test scores, between the groups in both schools is the same as in table **nine.**

---

*It was found impossible to match the intelligence scores of all the pupils in this group with pupils in the other groups without reducing the number of pupils.

However, the difference between the slide-film group and the film group in the Central school is .96 or7.47 in table ten. Table nine shows the advantage of the film group to be 1.33 or 10.67 points. Table ten shows the difference between the two groups in the total score to be even less significant. The new tabulation in table ten raises the map score difference in favor of the slide-film group .02 or .1 percent. (Central school).

Table ten accentuates the difference in favor of the slide-film group as compared with the film group at the Lincoln school by raising the differences between the total scores to 3.16 or 24.69%, and the map scores to 1.60 or 160.0 percent. (The differences shown in table nine are 2.60 points or 20.27, and 1.75 or 16.67 respectively).

A detailed study of the maps drawn by the pupils in response to question twelve reveals the fact that they could be classified into three distinct types. Type one, was a map which included the Isthmus of Panama and in most cases the lower and upper portions of North America and South America respectively. The canal was indicated by a line or double line. The locations called for in the question were indicated by dots or lines drawn to that part of the canal by the pupil. Type two, was a map drawn from the impression made on the subjects

by the film close-up-map of the Panama Canal Zone. This map was a black and white flat map. The white lines outlined the canal and lakes through which it runs. The canal was represented by a line running across the close up map in the same manner as recorded in sample map A type two. The lines which resemble the boundaries of fields in sample maps B and C of the type two responses represent the boundaries of the Central American States shown in another map by the film. Hence, sample maps B amd C, type two, represent a confusion of the Canal Zone Map and the Central American States Map shown by the film.

Type three, is the reproduction of the map used in the stereoptican lecture. This map was a relief map in a rectangular frame and is reproduced in sample A, type three.

A study of these reproductions shows that the pupils remembered lines but not the locations in the film maps. (See samples B and C type two.) No type-two maps were scored as high as sample A. Samples B and C are typical of the type-two responses.

The film groups saw only the film map, hence, we find their responses to be either type one or two. The slide-film groups saw both maps, the slide map first. The following table shows that even though the slide-film pupils had seen the film map nearest to the test in point of time that they preferred the slide map type three in making their responses.

Central School	Number responses		
Group	Type I	Type II	Type III
Slide-film	5	2	6
Film	9	12	0
Lincoln School			
Slide-film	7	1	14
Film	11	4	0

Table 11. The number of maps drawn by each group classified according to types I, II, III. (Experiment four.)

SAMPLE MAPS TRACED FROM
THE ORIGINALS WITH THE CLASSIFI-
CATIONS INDICATED AT THE TOP OF
EACH PAGE

CENTRAL SCHOOL	TYPE I MAP	PANAMA CANAL

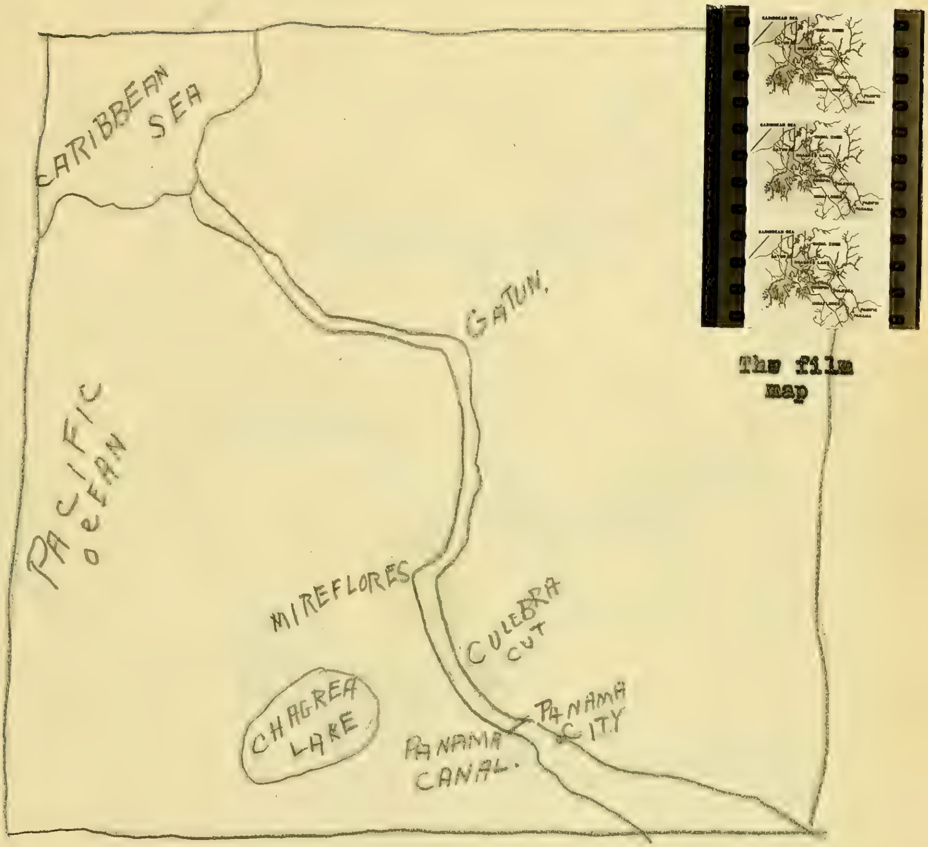
CLARENCE CARLSON

TEACHER MISS DURR
GROUP STEREO +FILM

Central School

Type II map Betty Beck
Teacher Miss Carney Group Film+Film

Sample A

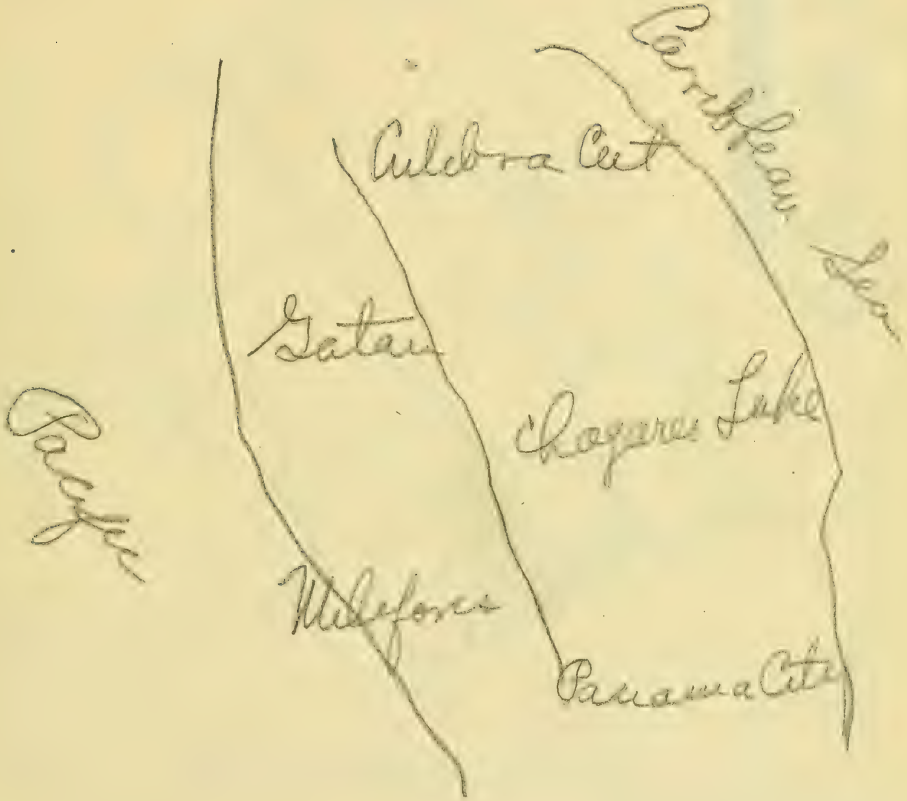


The film map

Central School Type II map Katheryn Erickson

Teacher Miss Carney Group film+film

Sample B

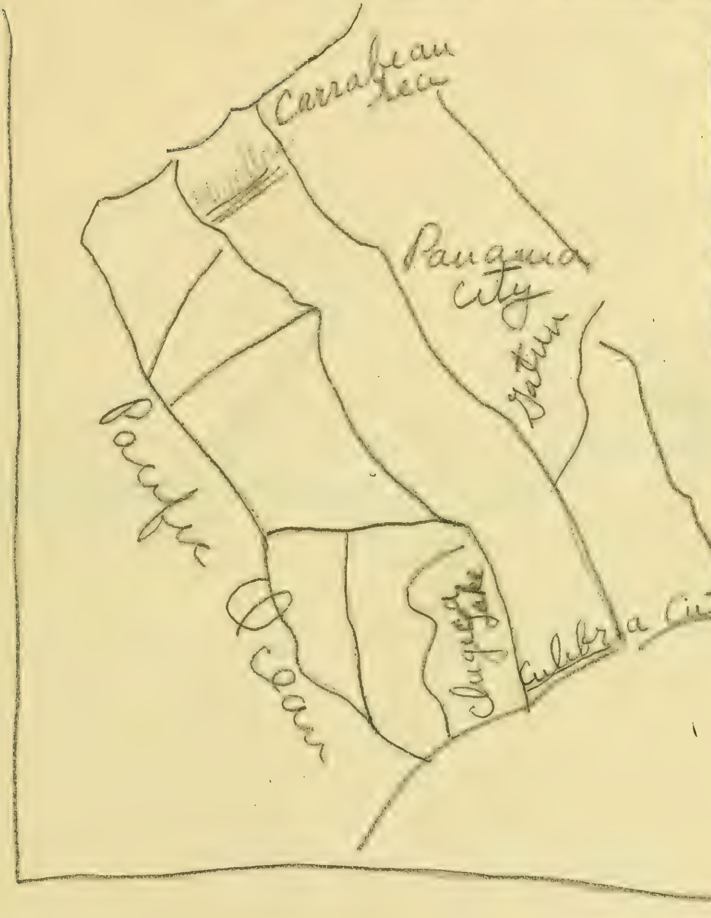


Type II map by Luella Cameron

Teacher Miss Longman Group Film+film
Lincoln School

Sample C

Panama Canal



The film map

PANAMA CANAL

LINCOLN SCHOOL

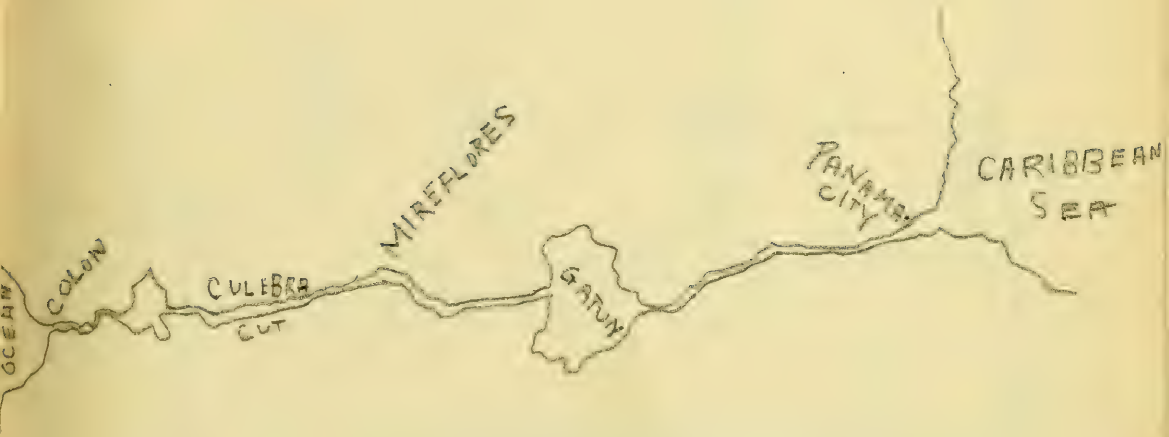
TYPE III MAP

WENDEL BAKER

TEACHER MISS GOODROW

GROUP STEREO + FILM

Sample A



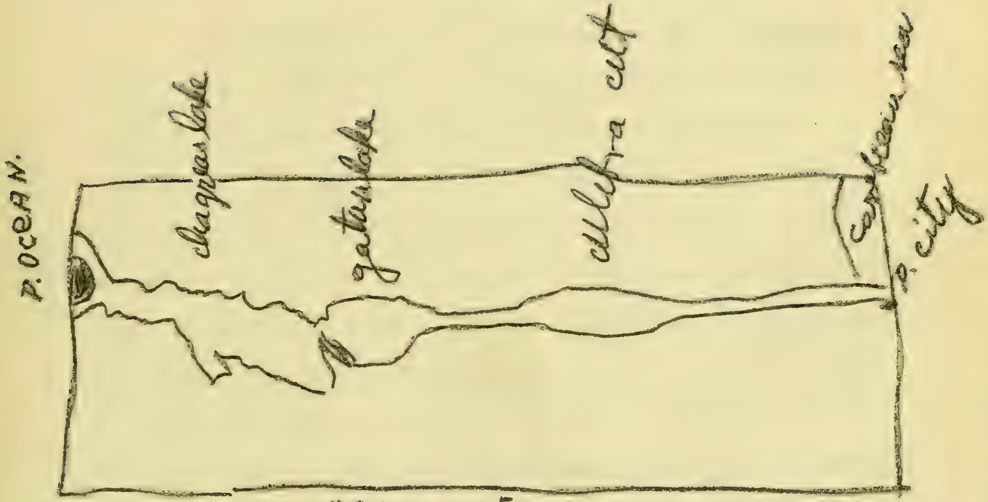
Type III Map

Lincoln School

Kenneth Munson

Sample B

Teacher Miss Goodrow
Group Stereo + film



MAP OF
PANAMA
CANAL

Experiment 5.

PROBLEM. The purpose of experiment five was to make a direct comparison between the information gained from one showing of a moving picture film and the information gained from a stereoptican lecture covering the same topic.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. Pupils from grades four to seven inclusive were selected for experiment five, from the Washington School, Evanston, Illinois. These pupils were formed into two comparable groups by taking every other pupil in each room starting with the front desk, left row. The pupils thus selected were formed into group D. The remaining pupils were placed in group E. The teachers estimated that the two groups thus formed in each room were approximately equal in general intelligence . (No intelligence test scores were available for the selection of these pupils on a more scientific basis.)

(2) Topic. The film used in experiment five was the same as that used in experiment four namely,

the Panama Canal and its Historical Significance, produced by the Society for Visual Education, Incorporated. The stereoptican lecture was also the same as the one used in experiment four. (For a detailed description of each see page93-96.

(3) The presentation of the topic. Group D, which, will be designated as the "slide group," received its instruction in the hall-way which was used for the projection room, after the following instructions were read to the group.

> "Today you will learn something of the history and significance of the Panama Canal. You must pay strict attention to everything you see or hear because you will all be given a test to find out what you have learned about the Panama Canal."

The instruction was divided into two phases. First the pupils heard a five minute discussion of the Panama canal. The discussion consisted of parts of the essay read to the oral-film groups in experiment four. This was followed by a fifteen minute stereoptican lecture. (For description of the stereoptican lecture see page 96).

Group E which will be designated as the film group assembled in the hall-way immediately fol-

lowing the conclusion of group D's instruction period. First it received the same instructions which were given to group D. This was followed by the five minute discussion read to the group D. (See above.) Then the group was exposed to a fifteen minute showing of the film.

(4) Tests. The tests used in experiment four were given to each group as soon as it had finished its period of instruction. See experiment four page 98 for a detailed description of (a) the instructions read to each group before the test (b) the test itself and (c) the scoring key.

The papers were scored by the writer and checked with those in experiment four.

RESULTS. The results of experiment five are shown in table twelve.

Washington School

	Grade	No. Pupils	Total Score Average	Emp Score Average		Grade	No. Pupils	Total Score Average	Emp Score Average
Group D stereo.	4	17	1.29	0	Group E Film	4	18	1.15	0
	5	15	2.00	.8		5	19	2.79	.21
	6	15	7.00	.93		6	9	4.63	.27
	7	16	7.12	1.19		7	14	4.00	.50
	entire group	63	4.30	.71		entire group	58	2.98	.18

Table 12. The scores made in experiment five by groups D and E, Washington School.

The average total score made by the sixty three pupils who saw the stereoptican slides and heard the lecture was 1.83 above the average score made by the fifty eight pupils who saw the film. This is a much larger difference than appears on the surface since the percent of superiority of the slide group was 61.44. In comparing the average scores made by the two groups on the map question we find the slide group made an average score over three times greater than that made by the film group, a 323 percent of superiority of, to be exact. An examination of the scores of the two groups by grades shows that the slide group in each grade made a higher average score than the film group in the corresponding grade in every instance, except grade four where neither group was able to do anything with the map question. The low average score made by the sixth and seventh grades in this experiment as compared with the scores made by the groups in the Central and Lincoln schools can be explained thru the fact that the time spent on instruction in the Washington school was about half that spent in the two former schools.

The results of experiment five would show that the stereoptican lecture was more effective in imparting the information concerning the Panama Canal called for in the test than the film.

Here again we find that the slide is more

effective in presenting this particular type of map material. An examination of the map responses according to the classification used in experiment four reveals the fact that fourteen of the film group attempted to draw type-two maps while twelve drew the type-one map. Of the fourteen type-two maps drawn none were more accurate or superior to sample B type-two shown on page 112. This universal lack of ability on the part of the pupils in experiments four and five to grasp the locations in the Film's close up map of the Panama Canal Zone shows that the map was either inferior in teaching these locations or that the film itself was a poor medium of instruction of this type.

CHAPTER V

The close of the school year concluded the research at Evanston with experiment five. However, new plans for the opening of school in September were formulated and the experiments were pushed forward on a more comprehensive basis.

The base of operations was shifted from Evanston to Urbana, Illinois, on account of the writer's change of residence. Through the efforts of Dean C. E. Chadsey of the College of Education of the University of Illinois, permission was given the writer by Superintendent Wm. Harris to use the pupils and equipment of the Leal and Thornburn public schools for experimental purposes.

The first step in the new program for experimentation was to make a more careful and thorough selection of pupils to be used as subjects. Consequently the writer personally administered the Illinois Intelligence Examination to all the pupils of the fifth and sixth grades in the Leal school and the seventh and eighth grades in the Thornburn school, Urbana, Illinois. These tests were given November 14 and 15, 1921.

The intelligence test papers were scored by four senior college students in Education under the supervision of the writer. Uniform and as accurate scoring as possible was obtained by having the assistants first check each others work which in turn was checked by the writer.

The second step was the selection of pupils to make up comparable groups. Two fifth grade groups and two sixth grade groups were formed at the Teal school by first piling all the fifth grade papers in rank order of test score in one pile and all the sixth grade papers in another pile. Then two groups in each grade were formed by placing the papers in two piles thus,

Pile	1	2
Group	A	B
Rank of Test Paper	1	2
	4	3
	5	6
	8	7

and so on.

These groups were designated as groups A, B C, and D. "A" and "B" were fifth grade groups while "C" and "D" were sixth grade groups

Eight groups were formed at the Thornburn school, four in the seventh grade, and four in the eighth

grade. In order to accomplish this all the papers were piled in order of test score for each grade. The groups were formed by piling the papers for each grade in four piles thus,-

Pile	1	2	3	4
Group	A	B	C	D
Rank of Test Paper	1	2	3	4
	8	7	6	5
	9	10	11	12
	16	15	14	13
	17	18	19	20

and so on

These groups were designated as the Thornburn A, B, C, and D seventh grade groups, and the Thornburn A, B, C, and D eight grade groups.

At the start of the experimental work each pupil was assigned to his or her group and remained in that group throughout the experimental period.

Large charts were prepared by the writer's assistants who recorded the names of the pupils in each group by rank order of intelligence test score. Opposite each pupil's name the following data were inserted, age in years and months, the test score, and intelligence quotient. From these charts it was possible to match pupil for pupil the various groups by test score, intelligence quotient, and chronological age. This procedure eliminated the differences in number and ability between the groups

which existed in the Evanston experiments. Furthermore, it made possible the easy elimination from the groups of those pupils who were opposite pupils whose absence during the memory test or original test unbalanced the number and ability of the groups. For example, if in an experiment using two groups we found pupils "e", "f", "g", and "h" in group A were absent part of the time, the corresponding pupils "e", "f", "g", and "h" in group B would be counted as absent.

The original number of pupils in each group was as follows;

Leal School

Number of pupils	Group	Grade
34	A	V
34	B	V
36	C	VI
36	D	VI
	Thornburn School	
32	A	VII
32	B	VII
32	C	VII
32	D	VII
42	A	VIIII
42	B	VIII
42	C	VIII
42	D	VIII

Table 13. The arrangement of pupils per group per grade in the Leal and Thornburn schools, Urbana, Illinois.

Two methods were used to insure the reliability of the methods of using parallel groups in the Urbana experiments. First, the groups were rotated from experiment to experiment so that each group would recieve a different method of presentation and second, all of the experiments, with the exception of experiments 8 and 14 were run in duplicate in another grade or school

All of the films used in the Urbana experiments were produced by the Society for Visual Education, Incorporated. On the receipt of each film the writer carefully timed the film caption by caption and scene by scene with a stop watch at a set speed for each film. The films were of different length and this fact is reflected in the different lengths of time devoted to the presentation periods. However, the speed set for a given flim was not necessarily the speed set for another. Hence, some films were projected at a slightly slower rate than others. This fluctuation in the rate of projection from film to film was purely arbitrary but the rate of projection for any given film was fixed and strictly adhered to by the operator.

The proportion of time spent on different items by the film was thus accurately determined and the oral instruction guided accordingly.

The projection room at the Leal school was the sixth grade room used by the principal of the school, Miss Wiley. It was equipped with a muslin screen and opaque window shades, the projection distance being about 20 feet. At this distance the picture was very bright and within the range of the vision of every pupil in the room.

The projection rooms at the Thornburn school were two in number. A small assembly hall served as the projection room for the experiment six. It was equipped with opaque shades doubled and a silvered screen. The projection distance was 34 feet. This room was being used as a regular class room on account of the crowded conditions of the school.

The second Thornburn projection room was the geography department's eighth grade class room. This was used for all the experiments performed at the Thornburn school after experiment six. The room was long and narrow and equipped with double opaque window shades and a specially prepared muslin screen. The projection distance was 28 feet. The image was very bright under such conditions. The screen was within the range of vision of every one in the room.

The Thornborn school was equipped with the Keystone "600 set" of slides and stereographs which were used extensively in connection with the geography and histroy classes. Hence the pupils in the Thornborn groups had been trained in the technique of learning from pictures.

The spirit of hearty cooperation which the pupils, teachers, and principals evidenced in the Leal and Thornborn school experiments certainly augured well for the success of the research.

CHAPTER VI

Experiment 6.

PROBLEM. The writer selected an administratively easy experiment to start the research in Urbana knowing that initial success was desireable. The purpose of the experiment was to show the relationship existing between the information gained from (a) two showings of a moving picture film and (b) one showing of the same film during which oral explanations were given. The oral explanation was given while the film was running and while it was stopped at each scene. In other words this experiment attempted to answer the question of whether or not it is more effective to stop a film and talk about it during the course of its presentation than to let it run straight thru without comment or stop. The use of the American portable projector made this comparison possible.

DESCRIPTION OF THE EXPERIMENT. (1) *Subjects.*

Groups A and B of the seventh grade and groups A and B of the eighth grade were selected to act in the capacity of subjects.

(2) Topic. The film selected for experiment six was another history film with the title,"Canals in United States History."

(3) Presentation of the topic. On November 29, 1921, groups A seventh and eighth grades were marched into the assembly room and seated in front of the screen. They were given the following instructions by the writer;

> "Today you will learn something of the story of the influence of canals on United States History. The film which I am going to show will be run thru twice. Pay strict attention to every thing you see for you will be tested at the end of the period to find out what you have learned."

Following these instructions the groups were exposed to two showings of the film, each showing occupying fourteen minutes. Immediately following the instruction period the test was administered.

Groups B seventh and eighth grades were marched into the assembly room and seated in front of the screen. They were given the following instructions;

> "Today you will learn something of the Story of the influence of canals on United States History. The film which I am going to show you will be stopped from time to time so that I can discuss with you the story of the film.

> Pay strict attention to every thing you see and hear for you will be tested at the end of the period to find out what you have learned."

Following these instructions the groups were shown the film for twenty-eight minutes which was stopped during each scene and at the "tables" (see outline of the film) during which the writer explained the significance of the material at hand. The instruction period was followed by the test.

The outline of the film by captions is as follows;

[illegible]

History 9

CANALS IN UNITED STATES HISTORY

Produced by

SOCIETY FOR VISUAL EDUCATION, Inc.
Chicago, Ill.

Foreword:-

The purposes of the reel on canals are to show the interesting changes in type and dimensions which they underwent, to make clear their importance in our commerce, and to point out the relationship of canals to the growth and development of our country.

OUTLINE OF CONTENTS
(Titles underlined)

Early freight carriers were slow

Motion-pictures of oxen hauling logs; of dog-drawn wagons

States which were built up with the help of canals

Animated map: showing names and routes of canals. A tabulation shows

How population increased during the era of canal building, 1820-1840

Actual work on the Erie Canal was begun in 1817 by Governor DeWitt Clinton of New York

Portrait of Clinton reproduced (Note: credit due to the Newberry Library, Chicago, Ill.)

A new chapter in our commercial development began with its opening in 1825

Motion-pictures of old-fashioned locks in action

It had cost [illegible] to ship a barrel of flour from Buffalo to Albany. The Erie Canal cut the cost to 30 cents

Motion-pictures showing canal

A chain of prosperous towns and cities grew up beside the canal

Animated map: showing names and locations along canal; New York Canals 1840; Railroads Competing 1840; Pennsylvania Canals 1840; Pa. Railroads Competing 1840; New York Barge Canal

But railroads became the rivals of canals as freight carriers----

Motion-pictures of freight cars beside water

---and many small canals were abandoned

Motion-pictures of abandoned canal

However, rail rates have continued to rise---

Tabulation shows cost of shipping a bushel of wheat from Buffalo to New York in various years by rail and by canal

---so that, for economy, barge canals are being used

Great New York State Barge Canal, completed 1918

Motion-pictures of New York State Barge Canal

Other canals were built to avoid dangerous rapids or shorten distances

Animated maps: showing location and setting of largest canals of this character- Cape Cod, Niagara, and Sault Ste. Marie

Three main types of canals have influenced this country's growth

1. Those which served as water highways before the railroads came
2. Those by which ships reach sea-ports safely, or avoid obstacles in lakes and rivers
3. The Panama Canal, connecting the Atlantic and Pacific Oceans

The Panama Canal shortens the ship route from New York to Pacific Ocean ports

Animated map of the Panama Zone, and principal points enroute. Animated map of western hemisphere- showing route from New York to San Francisco via Cape Horn, 40 to 50 days; via Canal, 18 to 20 days

It saves freight expense across the United States

Chart- Cost of shipping 100 lbs. from New York to San Francisco

Machinery	Dry Goods
$2.40 via rail	$6.81 via rail
$1.92 via canal	$5.70 via canal

Rates via canal save 1/5 the cost by rail

Animated map- showing canal route via Panama; rail route across continent

Other great waterways are planned for early development

Animated map- of United States and Canada- showing proposed routes of Lakes to Gulf of Mexico and Great Lakes-St. Lawrence deep waterways

(4) The Tests. At the end of each instruction period the pupils were given a test which had been made out by the writer's assistants. The test was two fold in nature calling for responses to questions and the drawing of maps. The test was mimeographed. Before taking the test each group received the following instructions;

> "First write your name, grade, date, and home teacher on every sheet. Then answer the questions just as rapidly and as well as you can. Put your answer in the blank spaces provided. You will all be given time to finish. When you are thru with your test fold the three sheets together, thru the middle, and bring it to the table here."

After this first test a memory test was given the four groups December 20, 1921, three weeks later. The memory test was exactly like the first test in every respect.

The original test papers and the memory test papers were scored by one of the writer's assistants. Two months later another assistant checked and rescored the papers. Differences in scores were checked by the writer and a final score thus secured. The questions and correct answer score key follow;

1. How did early settlers carry their goods and freight from one place to another?

2. What was the trouble with this early kind of carrying things as compared to modern methods?

3. Why were the first canals built in this country?

4. Name and locate on your map five of the early canals. Show the place where the canal runs by a line.

5. Most of the early canals were built between the dates_____to______.

6. What famous canal was built by Governor De Witt Clinton of New York?

7. On what date did Governor Clinton start to build this canal?

8. When was this canal completed?

9. What is a canal?

10. How does a canal help the development of the region in which it is built?

11. How much did it cost to send a barrel of flour from Buffalo to Albany before the canal was built?

12. How much did it cost to send a barrel of flour from Buffalo to Albany by way of the canal?

13. Name four of the prosperous towns that grew up beside the Erie canal.

14. What is a lock in a canal?

15. Describe how a lock operates.

16. What influence did railroads have on the use people made of canals?

17. How much more does it cost to send things by railroads now than by canals?

18. How has this fact influenced the building of canals?

19. What canal was built in 1918 in one of our Eastern States?

20. What three kinds or types of canals are there? Name an example of each.

21. Why was the Panama canal built?

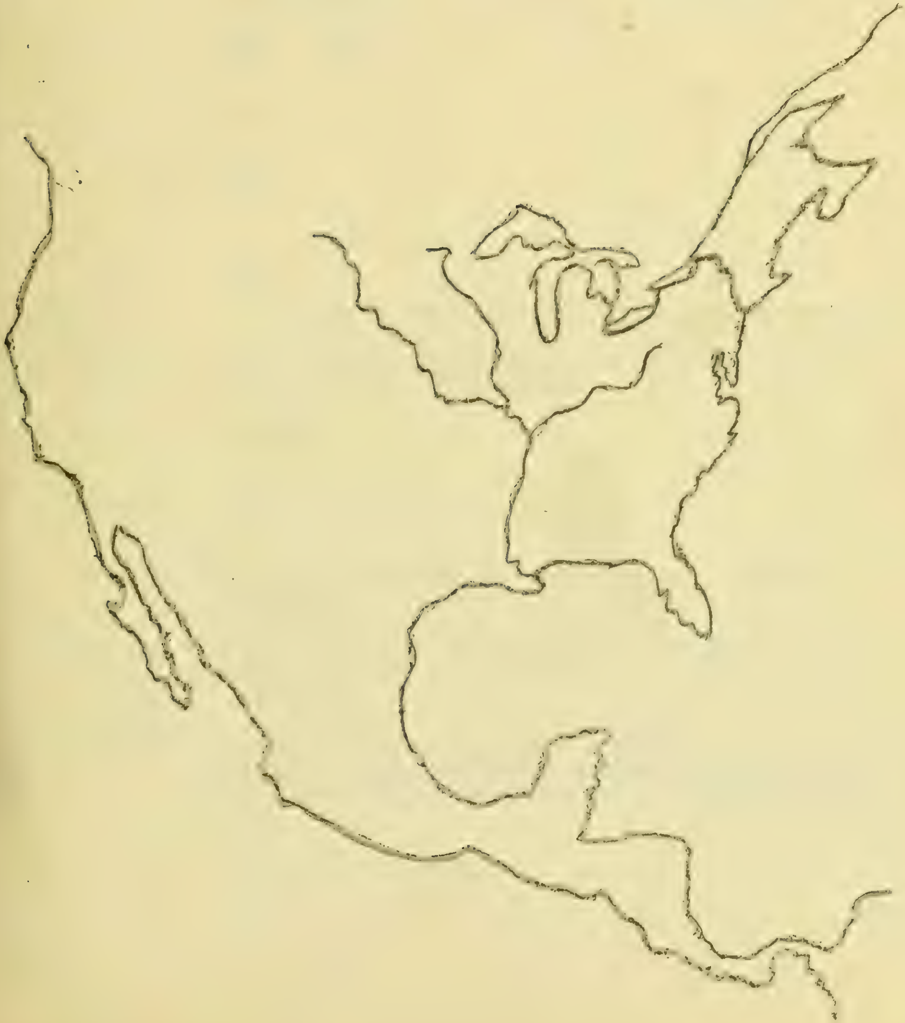
22. On the back of this sheet draw a map of the Panama canal showing the location of the Caribbean sea, Panama City, Gatun, Culebra Cut and the Pacific Ocean.

23. How much less does it cost to send things from New York to San Francisco by the Panama Canal than by railroad?

24. Name two new canals which are being planned to be built.

Sample of map used
in test.

NAME GRADE TEACHER



B. R. BUCKINGHAM, DIRECTOR

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EDUCATIONAL MEASUREMENTS

Answer key for experiment six. The number of points credit given for each answer is indicated to the left of the question in brackets.

(1) 1. By oxen and wagons.

(1) 2. Too slow and laborious.

(1) 3. Too make travel and commerce easier.

(5) 4. (One point for each canal correctly located on the map.)

(2) 5. 1820 1840

(1) 6. Erie

(1) 7. 1817

(1) 8. 1825

(1) 9. A canal is a water way for boats dug by people.

(1) 10. Helps (a) commerce, (b) trade, and (c) travel and (d) builds up country.

(1) 11. $10,00.

(1) 12. $ .30

(4) 13. Buffalo, Lockport, Rochester, Troy, Utica or Syracuse.

(2) 14. A lock is a gate in a canal which holds back water,(1); so that boats can go up or down hill. (1)

(2) 15. It is operated by gates (1) which open and shut letting water flow into apartments below raising the level of the water and with it the ship.(1)

(1) 16. Railroads decreased the use of canals by shipping goods cheaper.

(1) 17. One fifth more.

(1) 18. It has increased the building of canals.

(1) 19. Great barge canal in New York.

(3) 20. (a) water highways (b) avoid obstacles (c) Panama canal connecting oceans.

(1) 21. Shorten route from New York to San Francisco.

(5) 22. (One for each correctly located.)

(1) 23. One fifth less.

(2) 24. (a) Lakes to Gulf (b) Lakes to St. Lawrence river to Atlantic.

In question 16 one point was given if pupil gave any one or all of the four a, b, c, d.

In questions 14 and 15 one point for each part of the answer was given as indicated by the figures (1) in brackets.

THE RESULTS. The results of experiment six are given in table fourteen.

Thornburn School. Original test November, 29, 1921

Group	Grade	No. pupils	average chronological age in years	average intelligence test score	average intelligence quotient	average score questions	M D	average score map	M D	average score total	M D
A film	7	25	13.29	78.56	101.5	13.96	2.44	.61	.62	14.60	2.69
B film-talk	7	25	12.97	78.56	105.08	15.76	3.69	1.52	1.06	17.28	4.39
A film	8	34	13.87	92.89	108.06	15.61	4.06	.76	.73	16.37	4.65
B film-talk	8	34	14.23	92.87	106.7	14.94	4.21	.76	.81	15.70	4.51

Thornburn School. Memory test
Three weeks. December 20, 1921

							% loss			% loss *			% loss	
A film	7	25	13.29	78.56	101.5	11.28	20	2.93	1.08	77	1.12	12.36	16	2.64
B film-talk	7	25	12.97	78.56	105.08	12.56	21	3.33	1.52	0	1.02	14.08	19	3.96
A film	8	34	13.87	92.89	108.06	12.17	22	3.94	.67	12	.78	12.84	22	4.15
B film-talk	8	34	14.23	92.87	106.7	11.32	25	3.91	.56	27	.76	11.88	25	4.25

Table 14. The results of experiment six giving the original test scores and the per cent of loss by each group in the memory test.

*% of gain.

An examination of table fourteen shows that the film-talk group B made the higher score on the question, map, and total scores in the seventh grade. This situation is reversed in the eighth grade where the film group A made the higher score in the question test and total score.

The difference between the groups in the seventh grade is greater than the difference between the eighth grade groups. In the map score the seventh grade group B is over two times higher than the film group A, and twice as high as the scores made by the two eighth grade groups. The two eighth grade groups made the same score in the map work.

The results of the original test in experiment six at least show that the method of talking while the film was running or while it was stopped was a big advantage to the seventh graders and not so great a disadvantage to the eighth graders.

The memory test scores indicate that the eighth grade groups were able to retain less of the material than the seventh graders in terms of the residual score in groups B and the percent of loss for all groups. In map work the film groups residual score is .11 points or 19.6 percent higher than the film-talk group in grade eight. The memory score made by grade seven in map work shows a gain of 77% for group A and no loss

for group B. The seventh grade groups either, were more interested in the experiment and were motivated to check up their work, or were given some material on canals in class work during the interim. Either factor would account also for the lower memory loss in the seventh grade as compared with the eighth grade. The differences in percents of loss between the groups would indicate that the introduction of oral material lessened the permanency of the impression.

A careful analysis of the answers by questions for each group failed to reveal any interesting facts which would throw additional light on the results herein tabulated.

CHAPTER VII

Experiment 7.

PROBLEM. The accumulation of data from the first six experiments gave evidence that the film situation was not as effective as the teacher situation in teaching map work. Experiment seven was organized for the purpose of showing whether or not the single projection of a film containing a chart different from any map herein reported would be more effective than the teacher situation in teaching the same information.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The subjects selected for experiment seven were the seventh and eighth grade groups C and D in the Thornburn school.

(2) Topic. The film selected for experiment seven was entitled, "Waste Disposal in Cities." This film on sanitation was considered one of the best produced by the Society for Visual Education. The charts in the film were the animated cartoon type illus-

trating the process of waste disposal after the process had been described with actual pictures. In other words these charts summarized the first half of the film.

The writer copied the charts direct from the film by throwing the film frame desired thru the projector onto a large white card board.

(3) Presentation of the topic. On November 20th, 1921 group 3, seventh grade, was assembled in the geography class room which was used for the projection room. (See above page 127.) The following instructions were then given to the group;

> "Today you will learn something of the story of waste disposals in our cities. First I am going to read a letter to you written by the man who made the film. Pay strict attention to everything you see and hear for you will be given a test at the end of the period to find out what you have learned."

The writer then read the following letter;

A LETTER TO THE CHILDREN FROM THE MAN WHO MADE THE PICTURE

> Dear Children:
>
> Long ago when people lived far from one another, the problem of disposing of wastes belonged to each family, as it still does in country sections. But now that we live in closely settled towns

and cities, it naturally follows that the town or city must take care of the wastes.

In the picture today I shall show you how this is done. You will see how the wastes from your houses are carried away thru big sewers and disposed of by the city. Imagine what an undertaking it is to dispose of millions of gallons of sewage every day! Cities do this in different ways. If your own city is on the seacoast, the sewage is probably turned into the ocean. If you live on a lake or river, the sewage may be turned into the water directly, or it may be purified first.

Sewage disposal is one of the things which your city government does for you, and just one of the many ways in which your city is giving you the best chance to grow up healthy and happy. The children in the picture wish that you could see the beautiful stream where the purification of their city's sewage is completed, and catch some fish and tadpoles with them. They join me in sending love to you.

C. E. Turner,

Massachusetts Institute of Technology.

After the letter was finished the film was shown to group C for twelve minutes. The film outline by captions follows:

SCHOOLFILMS

WASTE DISPOSAL IN CITIES

Produced by

Society for Visual Education, Inc.
Chicago, Illinois

Arranged and directed by C.E. Turner,
Massachusetts Institute of Technology.

Foreword;

The purpose of the reel on the disposal of waste from cities is to point out the various origins of waste material, the way in which it is collected, and the two satisfactory methods of its disposal. Both employ natural agencies; the first, the tides of the sea; and the second, bacteria.

(Note. The Illustrations are taken direct from the film.)

Outline of Contents
(Titles Underlined)

Waste comes from the house

A picture of a typical house.

From the sink, washbowl, water-closet, bathtub, refrigerator, and washtub

An architect's drawing of a house in cross-section, showing how the plumbing is installed. (See chart one copied from the film, page)

It flows to the street sewer

A picture of a street and three buildings taken from above, followed by a diagram showing the house sewers entering the street. (See chart 2.)

From street sewers to collecting sewer

A picture of a section of the Boston shore front, followed by a diagram showing the street sewers running into the intercepting sewer. (See chart 3 page)

Boston sewage is collected in tanks at Moon Island...

A panerama of the collecting tanks and gate house at Moon Island.

The tanks and gate house
at Moon Island

..... and stored until the tide begins to go out, when it is discharged

A picture of the outlet pipe through which the sewage begins to flow, pouring out in a torrent which the eye can follow far out into the bay.

The sewage going out
with the tide.

The City of Brockton is not near the water

Its sewage, therefore, must first flow down to a pumping station

A picture looking down on the pumping station, which is at the lowest point in the city.

Electric pumps send it three miles beyond the city to a purification plant

The electric pumps in action.

.... through a great pipe

A section of the sewer pipe, showing its size by allowing a little girl and her father to enter the picture.

There it is sprayed upon a trickling filter

A picture of the trickling filter, or rock filter.

The rock filter showing sprays in action

The rocks are covered with a layer of bacteria which purify the sewage by converting the harmful organic matter into harmless minerals

One of the rocks is picked up from the filter and it is seen to be covered with a glistening coating of organisms.

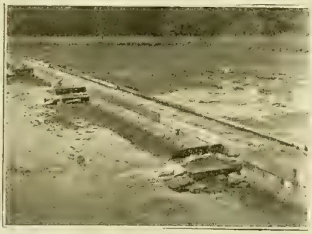
The rock covered with a coat of bacteria

Then the solids "settle out" in a big tank

The picture swings from the filter to the big settling tank.

Then the sewage flows upon sand beds

Several of the one acre beds are shown.



Sewage flowing on a sand bed

The sand grains, too, accumulate a coating of bacteria

Some sand is picked up from the filter bed and brought up for closer inspection.

The bacteria may be washed off and seen through the microscope

A close-up picture shows the washing of the sand, the staining of the bacteria in the wash water, and the picture of the bacteria themselves.

The microscopic picture
of the bacteria

This is how the swage flows onto a sand bed

The dosing of a bed which has been rested is shown

The sewage is well purified when it comes through the sand beds

The partially purified sewage effluent is seen coming from the large under drain of a sand bed.

Contrast this effluent with the untreated sewage

Jar of untreated sewage beside jar of purified sewage.

The process you have seen will now be reviewed and explained by a diagram

Animated diagram of the whole process of purification. (See chart 4 page)

It is clear, but contains some dissolved material.

The flowing water in the effluent drain is shown to be clear. The bottom over which the effluent is flowing may be clearly seen.

The drains flow into a little brook

The brook into which the sewage flows

The brook

Where the drains come in, there are many bacteria to feed upon the nearly purified sewage

A close-up of the collection of water from the brook near the effluent drain. Some of the water is put under the microscope and living bacteria are seen.

Below this point there are single-celled animals to eat the bacteria

Some distance down the stream the little girl and the bacteriologist are shown collecting a sample. A close-up shows the completion of this task and the material is put under the microscope. There follows a microscopic picture of the protozoon Carchesium feeding upon the bacteria. (See chart 5, left side, page)

Farther down are "water fleas" which feed on these

Still farther down the stream the bacteriologist is seen and in a close-up the little girl is shown how "water fleas" may be seen through the microscope in water taken from the brook. The "water fleas" are shown on the screen.

Still farther down the stream are minnows to eat the "water fleas"

Here a boy is seen fishing. A close-up shows him catching minnows.

The minnow, the boy and
the girl

Frogs and tadpoles

The bacteriologist and the little girl examine a frog and a tadpole which the boy catches for them at the edge of the water.

The biggest catch was a trout

The boy proudly exhibits a trout which he has caught

And a few miles below purification is complete

A picture of the purified stream.

Acknowledgment and thanks for their valuable cooperation in the construction of this film are given to the Department of Public Works, Sewer Division, of the City of Boston; and to the City Chemist and members of the Sewer Department of the City of Brockton, Mass.

At the close of the instruction period the pupils were given a test.

Group D, seventh grade, followed group C to the geography class-room. The following instructions were then read to the group;

> "Today you will learn something of the story of waste disposal in our cities. First, I am going to read a letter to you written by the man who organized this material. Pay strict attention to every thing you see and hear for you will be given a test at the end of the period to find out what you have learned".

The writer then read the letter shown above.

As soon as the "letter" was finished the writer hung five charts on the front blackboard. These charts had been copied from the film by projecting a frame of the film on to a large sheet of card board 24x30 inches on which the writer traced the chart or diagram.

The writer lectured to the class for twelve minutes referring to the charts at the points in his lecture where it was necessary. The outline of the lecture following the film by captions is given below:-

"Waste Disposal in Cities."

(Film captions underlined)

A. Waste comes from the house. Refer children to typical house by illustration.

B. From the sink, washbowl, water-closet, bath-tub, refrigerator, and wash tub. Refer children to chart (1).

C. It flows to the street sewer. Illustrate by calling attention of pupils to streets outside windows where the sewer pipes run under ground. Also refer to chart (2).

D. From street sewers to collecting sewer. Call attention of children to fact that the small sewers empty into a large main sewer running down the main street in a city. Refer to charts 2 and 3.

E. Boston sewage is collected in tanks at Moon Island. Point out to children the fact that cities on sea coast can collect the sewage in

large tanks by the sea or ocean, tanks larger than the class room or building.

F. ---and stored until the tide goes out when it is discharged. Explain briefly the actions of the tide and how gates in the tanks can open when the tide goes out taking the sewage with it far out to sea.

G. The city of Brocton is not near the water. Cities and towns which are like Urbana not near a large river, lake or ocean must use some other means of waste disposal.

H. Its sewage, therefore, must first flow down to a pumping station. Explain how sewage comes from house thru street sewer to collecting sewer to pumping station.

I. Electric pumps send it three miles beyond the city to a purification plant-----. Ask the pupils how many have seen electric pumps (Show of hands). Describe their action and size.

J. -------thru a great pipe. Illustrate size of pipe by holding hand from floor. Pipe runs on top of the ground, or may run under the ground.

K. There it is sprayed on a trickling filter. Describe same and refer to chart (4).

L. The rocks are covered with a layer of bacteria which purify the sewage by converting the harmful organic matter into harmless minerals. Ask children if they know what bacteria are (show of hands). Explain. Show that rocks are size of fist or double fist and look brown or black with a glistening coat of jelly like substance full of bacteria.

M. Then the solids "settle out" in a big tank. Refer to chart (4).

N. Then the sewage flows upon sand beds. The one acre beds are described. Refer to chart (4).

O. The sand grains too accumulate a coating of bacteria. Explain that the same process goes on in the sand beds as in the rock beds. Refer to chart (4).

(Note the next four captions and pictures in the film (see film outline) were not shown the film group and this material was not touched upon in the lecture).

P. The process you have just seen will now be reviewed and explained by a diagram. Refer to charts 3 and 4 briefly. (Note: Film spent two minutes on this review by charts. Lecture took one half minute to allow for reference to chart 4 in M, N, O, Q, and R).

Q. It is clear but contains some dissolved material. Refer to chart (4).

R. The drains flow into a little brook. Refer to chart (4).

S. Where the drains come in there are many bacteria to feed upon the nearly purified sewage. Explain that process goes on in brooks. Bacteria drawn on board.

T. Below this point there are single celled animals to eat the bacteria. Refer to chart 5 left half.

U. Farther down are "water fleas" which feed on these. Refer to chart 5 right side.

V. Still farther down the stream are minnows to eat the "water fleas". Explain and continue story.

W. Frogs and tad poles.

X. The biggest catch was a trout.

Y. And a few miles below purification is complete. Conclusion of story.

This outline of the lecture was fashioned after the film outline to make the two parallel each other as closely as possible. The film was timed caption by caption and scene by scene by a stop watch in order to determine the exact amount of emphasis placed on each item. This served as a basis for the organization of the lecture in terms of the amount of time to be spent on each item.

The following photographs were made directly from the five charts used by the writer in teaching the oral-chart groups in experiment seven. These charts were copied directly from the film. A description of each chart accompanies it. The reader should compare these charts with the tracings shown on pages 178-191.

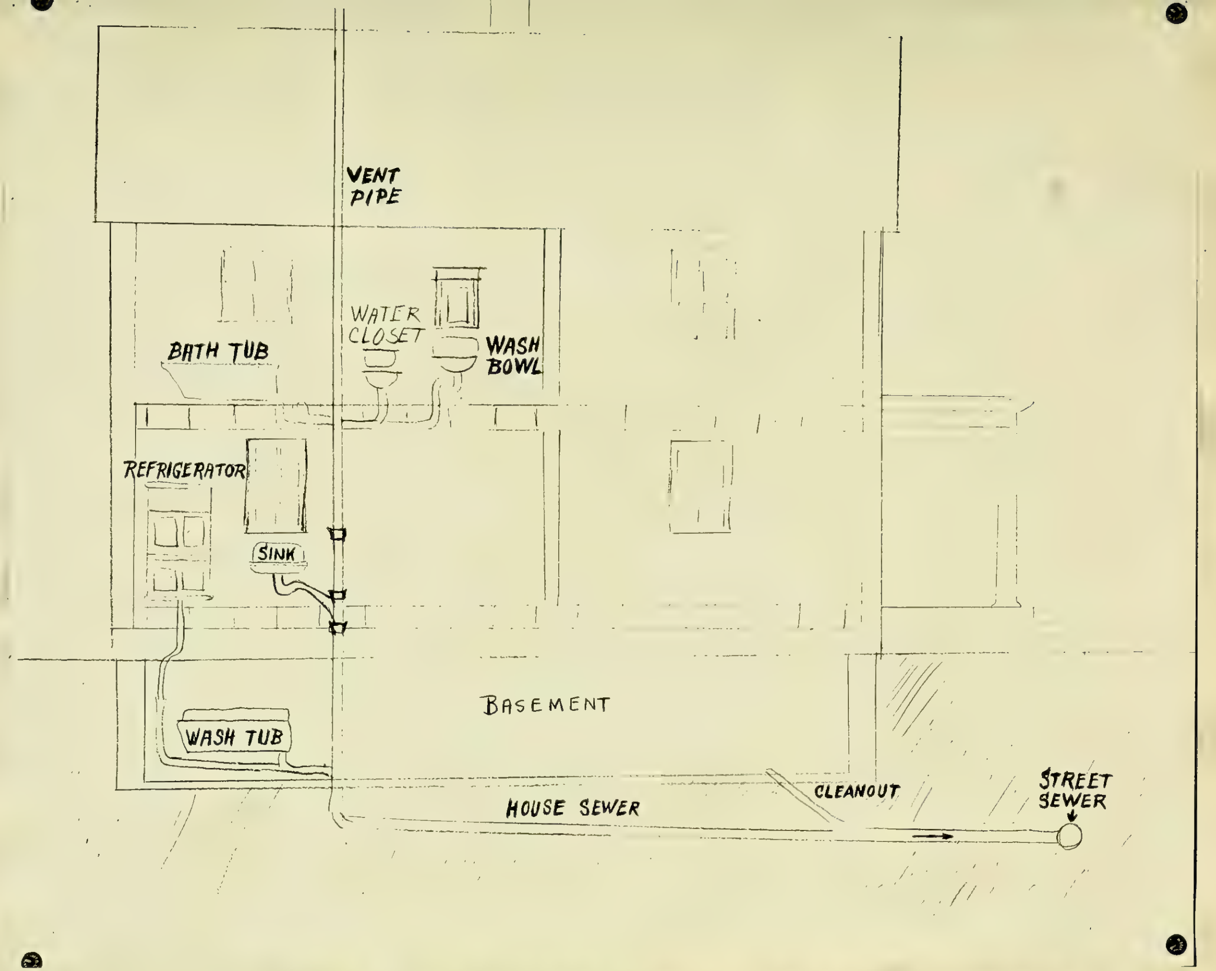


Chart 1. An architect's drawing of a cross section of a house showing the places from which waste comes and where it goes.

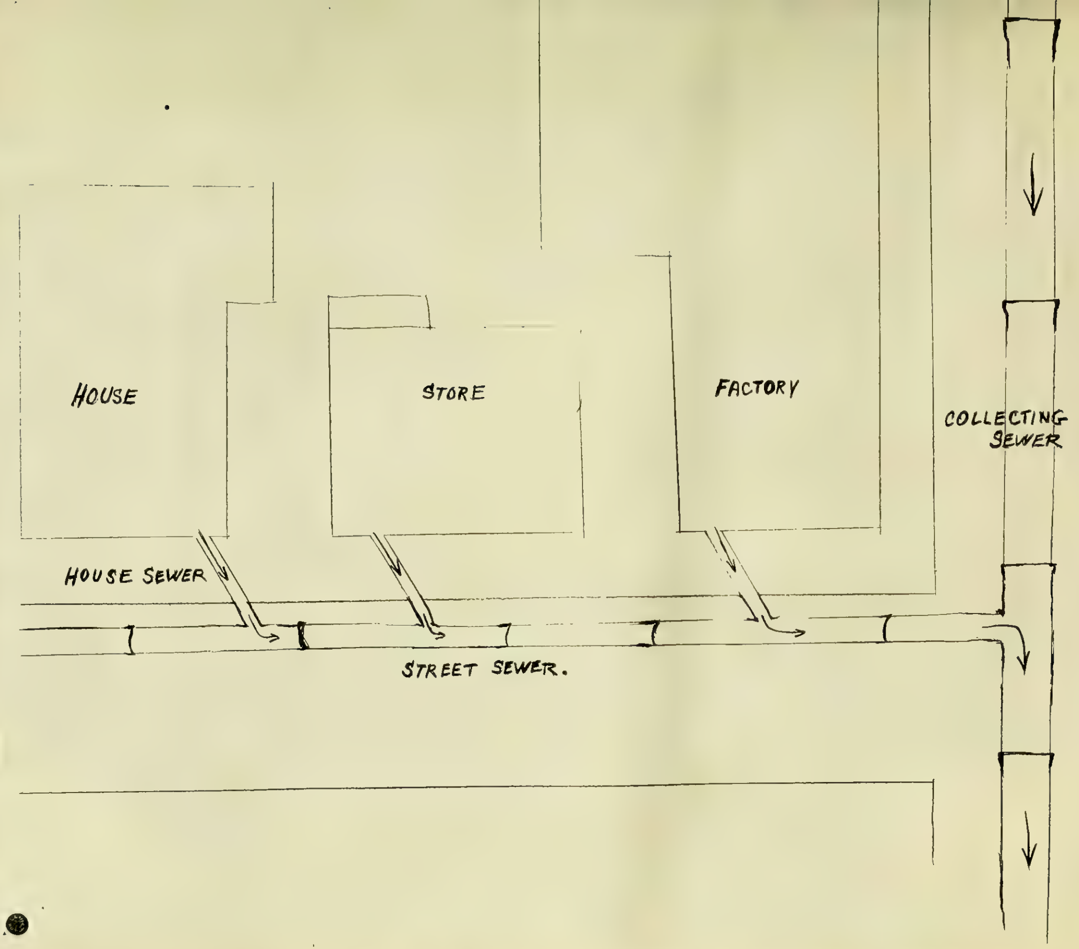


Chart 2. The relation of the house, store and factory to the street sewer and collecting sewer in any city are shown.

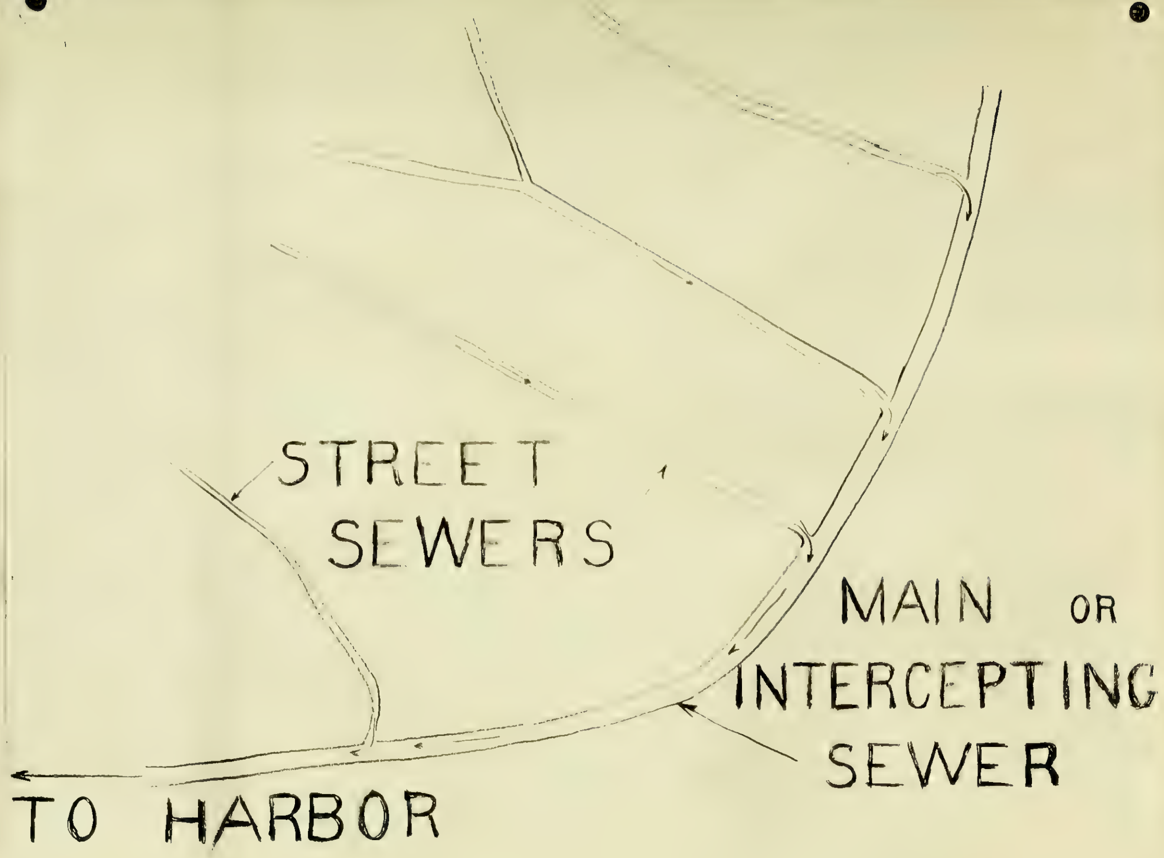


Chart 2. The relation of the street sewers to the main sewer in the Boston scheme is shown here.

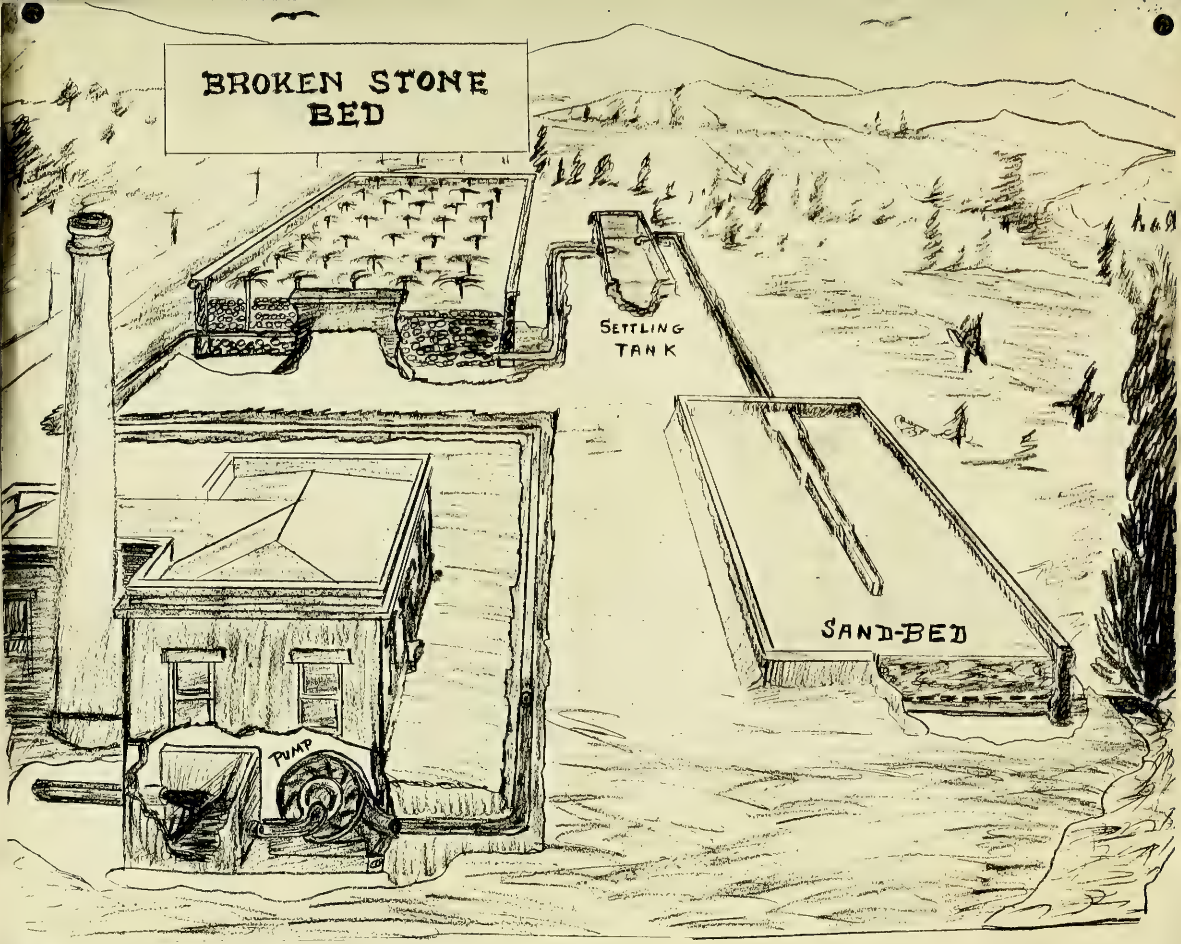


Chart 4. The purification station and pumping house.
In the film, this is an animated cartoon, the sewage being represented by a dark line. This chart was shown first, then each part was shown close-up, lastly this chart was shown again so that the process could be repeated throughout.

Chart E. The unicellular animals, left, and water fleas, right, which were shown in the film as representative of the purification agents in the stream. These are microscopic pictures as shown in the picture.

Groups C and D of the eighth grade Thornburn school received their instruction on the afternoon of November 30th, 1921. Group C was the film group. Group D was the oral-chart group. The instruction for each group was an exact duplication of that given to groups C and D of the seventh grade.

(4) The Tests. Immediately after each period of instruction the four groups were tested by a mimeographed three fold test prepared by the writer's assistants. The writer had not seen the test previous to his lecture. Before administering the tests the writer's assistants read the following instructions to each group.

> "First write your name, grade, and home teacher on every sheet you use. Then answer the questions just as rapidly and as well as you can. Put your answer in the blank spaces provided. You will all be given time to finish. When you are thru with your test turn the sheet over on your desk."

When this test was finished each pupil was given a blank piece of paper for a spontaneous composition test. The instructions given for this test follow;-

> "First write your name, grade, and home teacher on this sheet of paper. When that is done write all you can remember of the story of Waste Disposal in our Cities. You will be given time to finish. When you are through with your compositions fold the two sheets together through the middle and bring them to the desk".

This test called for answers to questions, reproductions of charts, and a composition. Hence, it is called a three-fold test. The compositions proved to be of little value because they were written after the pupils had refreshed their memory by answering the questions. The composition test should have come first. The papers were scored twice. The second scoring, serving as a check on the first, was done by a second assistant ten weeks after the first scoring was completed.

The composition test was scored in terms of the number of correct ideas reproduced. One point was given for each item. In order to secure uniformity of judgment as to what were correct ideas the writer trained an assistant specially picked for this work who scored all the compositions throughout and followed her own standard. These scores were checked by the writer and this same assistant twelve weeks later.

The questions used in experiment seven and the answer key follow:-

1. From what places in the house does the waste come?

2. Where does it flow to from the house?

3. Where does it go to next?

4. Boston sewage is collected in ________ at Moon Island.

5. When is this collected sewage discharged?

6. How does the City of Brockton differ from Boston?

7. Where must the sewage of the city of Brockton first flow to?

8. By what means is the sewage of the city of Brockton sent away?

9. Where is this sewage sent to?

10. There it is sprayed upon a ________________.

11. How is the harmful organic matter converted into harmless minerals?

12. How do the rocks which are covered with these organisms look?

13. Where do the solids settle out?

14. Then the sewage flows upon ________________.

15. What happens here?

16. How does the sewage look when it leaves here?

17. What does it still contain?

18. The sewage finally flows into a ___________.

19. Here it is further purified by ____________.

20. These are _______ by single celled animals.

21. What feed on these?

22. These in turn are eaten by _____ which the boy catches.

23. Make a diagram on the back of this sheet showing how dishwater poured into the kitchen sink would go from place to place until it reaches the ocean. (Boston)

24. Show in another diagram how waste coming from an inland city home would go until it reaches its destination.

Scoring Key

The point value of each question is placed opposite the question in brackets. In question one, one point was given for each item enumerated.

(6) 1. Sink, wash bowl, water closet, wash tub, bath tub, refrigerator.

(1) 2. To the house sewer.

(1) 3. To the street sewer.

(1) 4. In tanks.

(1) 5. When the tide goes out.

(1) 6. It is an inland city, or
It is not on the sea (or ocean)

(1) 7. To the pumping station, or
To the large collecting sewer.

(1) 8. By a pump, or in large pipes, or by machinery.

(1) 9. To a purification station, or a purifying plant, or place where it is purified.

(1) 10. A broken rock bed, or rock bed.

(1) 11. By the action of bacteria, or Bacteria feed on it, or, By bacteria.

(1) 12. Brown and slimy, or black and dirty, or a coating of jelly like substance. (Note: In the film group a number said they "looked like a piece of coal," no credit given.)

(1) 13. In the settling tank.

(1) 14. Sand beds.

(1) 15. Purified further, or purification almost completed, or bacteria continue to purify it.

(1) 16. Clear, or like pure water.

(1) 17. Bacteria, or dissolved material.

(1) 18. A stream.

(1) 19. Bacteria.

(1) 20. Eaten.

(1) 21. Water fleas, or minnows.

(1) 22. Minnows, or large fish.

Note. In problems 23 and 24 one point was given for each item correctly traced or drawn whether labeled or not. If the correct sequence was broken or inverted or changed by an insertion the incorrect portion was not scored and points were given for the remaining correct parts of the sequence. The items listed below were all of them shown in a diagram or chart by at least one pupil. Each item accepted follows:-

(9) 23. Sink, vent pipe, cleanout, house sewer, street sewer, main sewer, collecting sewer, tanks, gates, and ocean.

(26) 24. Sink, vent pipe, cleanout, house sewer, street sewer, main sewer, collecting sewer, sieve, pump, pump house, pipe to rock bed, sprinklers, seeps thru, clear sewage, pipe to settling tank, settling tank, pipe to sand bed, sand bed, seeps thru, stream, bacteria, uni-cellular animals, water fleas, minnows, fish, and water purified. (Note. Three pupils two in the oral groups and one in the film group showed fish being caught. No credit given.)

(35) Combined possible score for chart problems.

([illegible]) Total possible score in test. To get the "score" add up the points made on each question.

The memory test was exactly like the original test except the "composition" was not included. The memory test was given December 21st, 1921 three weeks after the original test.

The four groups which were to take the memory test were assembled in the assembly room and were given the following instructions.

> "You all remember the story of Waste Disposals in cities which you saw in the film or heard me tell do you not? (Give chance to answer, "yes"). Today I am going to give you a test to find out how much you remember of that story. Put your name, grade and home teacher at the top of your sheet of questions then answer as many questions as you can."

The memory test papers were scored in the same manner as the original tests.

RESULTS. Experiment seven proved to be the most satisfactory, from the standpoint of its administration, of the experiments discussed to this point. The interest of the pupils in the topic was very keen and the "chart problems" called for a complete reproduction of the two methods of waste disposal by each pupil, reproductions which could be easily scored. The chart problems were sequestial place tests.

Thornburn School. Original test. November 20, 1921.

Group	Grade	pupils	average chrono-logical age	average Intelli-gence test score	average Intelli-gence quotient	average score questions	% loss	M / D	average score chart	% loss	M / D	average score com-position	% loss	M / D	average score total	% loss	M / D
film	7	25	13.15	82.87	103.04	15.32		2.70	10.56		8.92	15.96		4.83	41.34		7.83
oral	7	25	13.15	67.57	106.28	16.40		4.14	12.56		5.42	16.40		7.38	45.44		7.04
film	8	35	13.70	93.40	109.0	[illegible]		3.36	11.09		4.10	21.17		7.84	49.40		8.14
oral	8	35	13.78	95.05	108.5	17.67		2.63	15.45		4.39	25.11		8.40	57.90		7.51
Memory test. Three weeks. December 11, 1921.																	
film	7	25	13.15	82.87	103.4	14.64	5	3.37	9.00	[illegible]	5.64	Composition Test	not given here		24.57		8.01
oral	7	25	13.15	67.57	106.28	14.40	12	4.91	11.35	10	5.41				26.60		6.15
film	8	35	13.70	93.40	109.0	14.17	14	3.24	8.71	26	4.92				22.88		6.21
oral	8	35	13.78	95.05	108.5	14.65	16	2.90	12.89	17	4.30				27.74		7.32

Table 15. The results of experiment seven giving the original and memory test scores and per cent of loss per each group.

A comparison of the average scores for each group in the original test shows that the oral-chart group D was superior in each item of the three fold test, this relationship holding for each grade. The seventh grade oral-chart group was even slightly superior to the eighth grade film group in both the question and chart tests.

Table fifteen shows the seventh grade oral-chart group D to be higher than the film group C by 1.08 points or 7.0 percent in the question test, by 2.00 points or 19.0 percent in the chart test, by .52 points or 3.2 percent in the composition test and by 3.60 points or 8.6 percent in the total score. The eighth grade oral-chart group D likewise is higher than the film group C by 1.03 points or 6.3 percent in the question test, by 3.53 points or 29.6 percent in the chart test, by 3.94 points or 13.8 percent in the composition test and by 8.50 points or 17.2 percent in the total score.

The most significant difference is manifest between the scores made by the two groups in the chart work. In the seventh grade the oral-chart group made a score 19% higher than the film group. In the eighth grade this difference is even more striking for the oral-chart group made a score 29% higher than the film group.

The average question scores show a superiority of 7.04% for the seventh grade oral-chart groups and 6.30%

for the eighth grade oral-chart group. While this difference is not as great as that manifest in the chart score it shows that the general information concerning waste disposals in cities called for in the questions was not under emphasized in the lecture.

The composition tests also show a superiority for the oral-chart groups but since the compositions were written after the question test had been completed they do not represent a spontaneous report on the part of the subjects.

The memory test scores in the seventh grade show the percent of loss for the film group to be lower than that of the oral-chart group in the question test and chart test. In fact the residual score of the film group in the question test is .16 points or 1.17 higher than the oral-chart group. In the chart test the oral-chart group is higher by 1.44 points or 14.5 percent.

In the eighth grade the residual score made by the oral-chart group in the question test is higher than the film group by .68 points or 4.87 percent. This is the reverse of the situation in the seventh grade except for the fact that the percent of loss in both grades for the question material is lower in the film group. In the residual chart score

the oral-chart group is 4.18 higher than the film group which represents a loss of 17 percent for the oral-chart group and 25 percent for the film group. Out of four cases where the percents of loss were compared the latter is the only instance where the film group did not recall a larger percent of the material which they recalled in the first test than the oral-chart group.

Ten pupils were selected at random from the seventh and eighth grades and were given the test used in experiment seven. These pupils had received no direct instruction on the topic Waste Disposal in Cities. The average score made by the group in each item of the test is as follows;-

Group	Grade	Average age	Average Intelligence test score	Ave. I.Q.	Average question score	Average chart score
Ten uninstructed pupils	7th & 8th	13.4	87.89	106.3	1.30	.40

We find that the average scores made by the ten pupils in the question test is .8 of one percent of the average score made by all the pupils taking the test in experiment seven and .2 of one percent of all the pupils taking the chart test in experiment seven.

The test used in experiment seven called for material and information which was for the most part without the experiences of those pupils who had not received direct instruction on the topic.

An examination of the responses to the chart problems in experiment seven shows that there is a decided lack of unity in the responses recorded by the film groups. For example, the writer tabulated the responses made by the pupils according to the types of error manifest in each response. It was found that all the errors made by both groups in answer to problem 23, the Boston scheme of waste disposal, could be classified under seven headings. The errors made by both groups in answer to problem 24, the Brockton scheme of waste disposal, were found to distribute themselves under ten headings.

The following schemes represent the classifications of the types of errors committed by the subjects in experiment seven.

Boston scheme.

23. Make a diagram on the back of this sheet showing how dish water poured into the kitchen sink would go from place to place until it reaches the ocean.

Classification of errors made by pupils answering question 23.

Type one. Pupil omitted part of sequential items. (Note. Every pupil in the experiment omitted part of each diagram hence all papers will be classified under type one.)

Type two. Pupil showed chart one only, viz the house and house sewer to street sewer.

Type three. Pupil's diagram omitted tank at Moon Island.

Type four. Pupil's diagram was disconnected. That is, the pupil traced the sequence thru to one point, then started the sequence at another point leaving a space between the two parts of the diagram on the sheet, and so on.

Type five. Part of the Brockton scheme was inserted in the sequence.

Type six. The diagram consisted of a mixture of hit and miss lines, meaning nothing.

Type seven. Pupil's drawing consisted of a line crooked at places and labled, sink, house sewer and so on.

(Note, for illustrations of each type see the following tracings.)

Brockton scheme.

24. Show in another diagram how waste coming from an inland city home would go until it reaches its destination.

Classification of errors made in response to question 24.

(Types are designated a, b, c, etc., to avoid confusion with Boston scheme.)

Type *a*. Pupil omitted part of sequential items. (Note. Every pupil in the experiment omitted part of each diagram hence all papers will be classified under type a.)

Type *b*. The pupil interchanged the sequence of items.

Type *c*. The pupil's diagram started with the collecting sewer, omitting chart 1.

Type *d*. The pupil's diagram started with the pump house, omitting chart 1.

Type *e*. The pupil omitted pump house on to the end or chart 4.

Type *f*. The pupil omitted pump house to sand bed inclusive.

Type *g*. Pupil's diagram was disconnected. (Same as type four above.)

Type *H*. Part of the Boston scheme was inserted in the sequence.

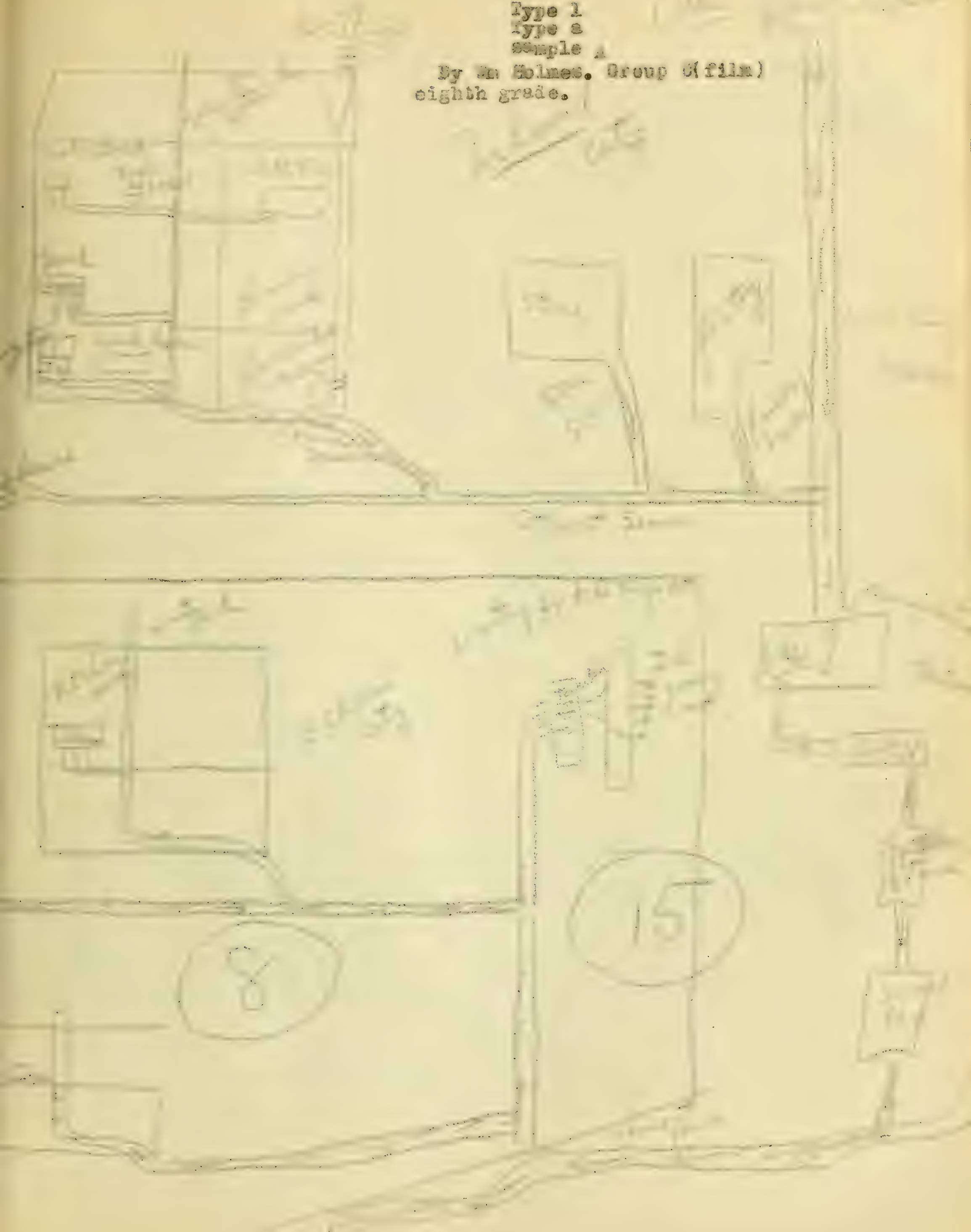
Type *i*. The diagram consisted of a mixture of hit and miss lines, meaning nothing.

Type *j*. The pupil's drawing consisted of line crossed at places and labled, sink, house sewer and so on. (Same as type seven.)

The following diagrams are illustrative of the types of errors classified above. These diagrams were traced from the original responses of the students and represent as nearly as possible the typical response in that classification.

Samples A and B, type 1, represent the two best eighth grade responses by pupils in the film group. Samples C and D, type 1, represent the two best eighth grade responses by pupils in the oral-chart group. These are submitted in order that the reader may observe the high grade of work done by the best pupils and compare the best work of the two groups. Samples A, B, C, and D show both the Boston and Brockton schemes. The figure in the circles represent the score assigned that diagram.

Type 1
Type a
Sample A
By Wm Holmes. Group C(film)
eighth grade.



Type 1

Type a

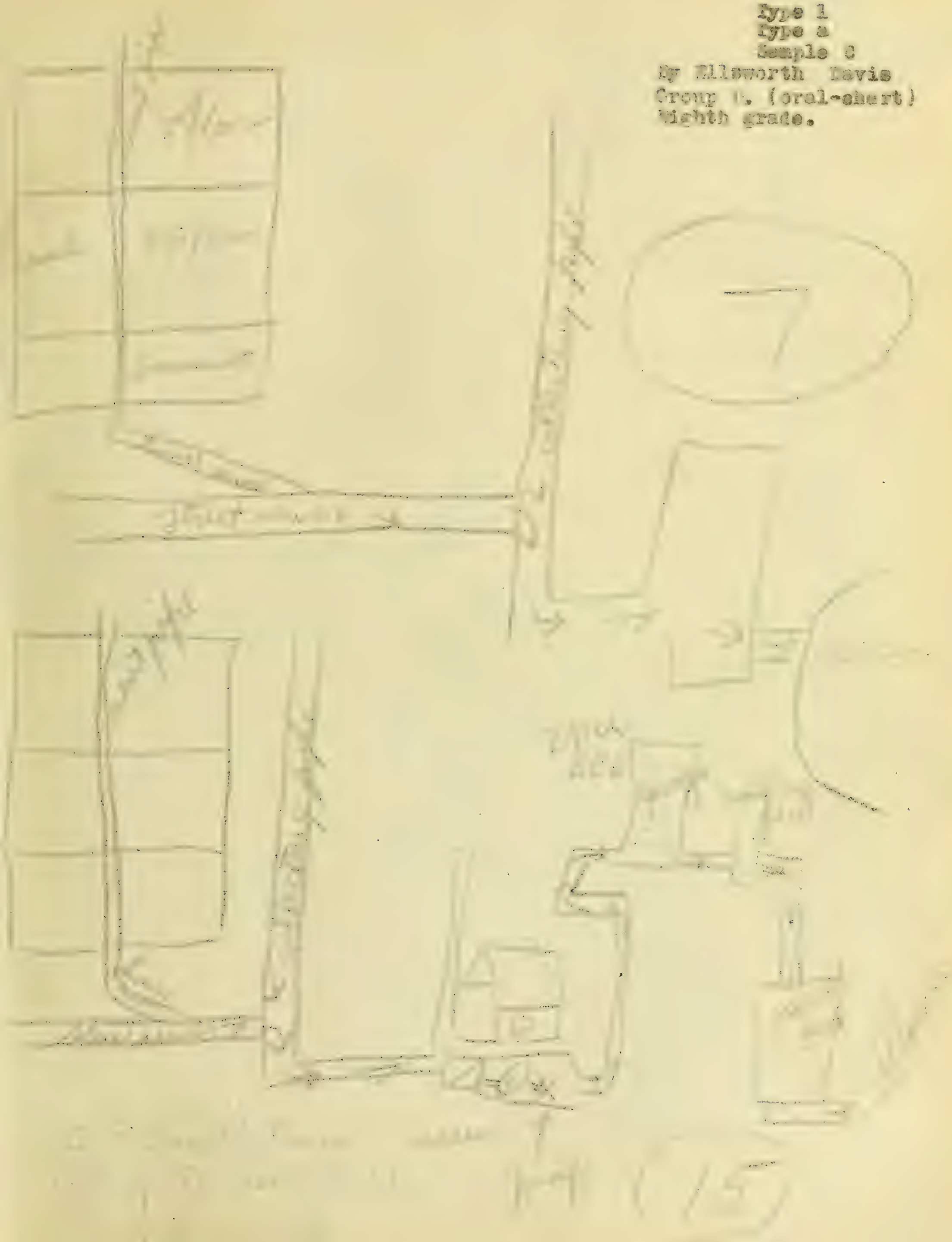
Sample B

by Rondes Quade, Group C, film, eighth grade.

6

15

Type 1
Type a
Sample C
By Ellsworth Davis
Group B. (oral-chart)
Eighth grade.



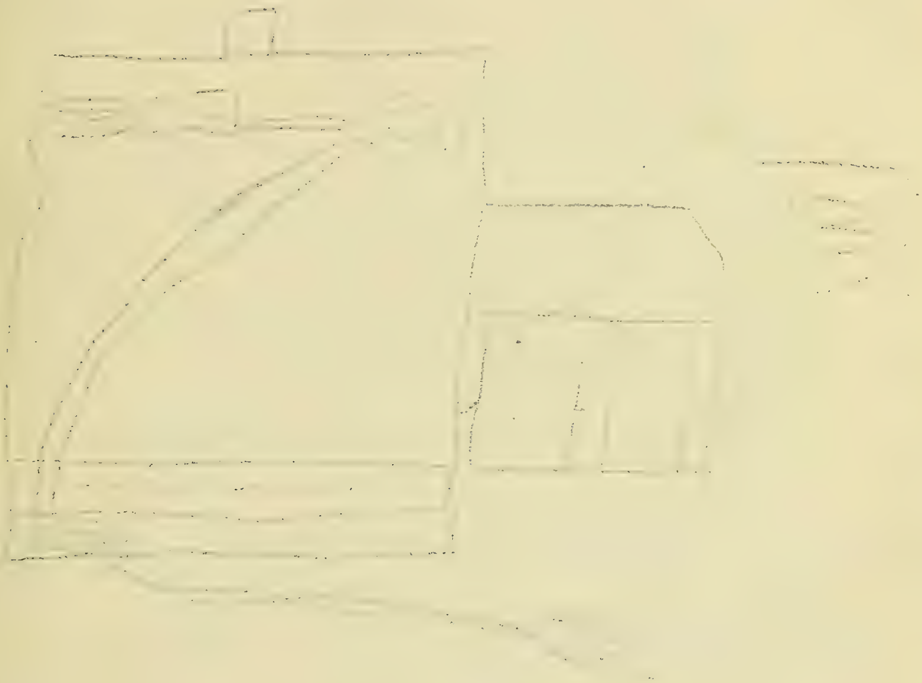
Type 1
Type a
Sample D
By Chas. Johnson. Group D
Eighth grade

By Chas Johnson
group D 8th class
Grade 8

Type two

Type e

By, Mildred Reno.
Group D (oral-chart)
Seventh grade



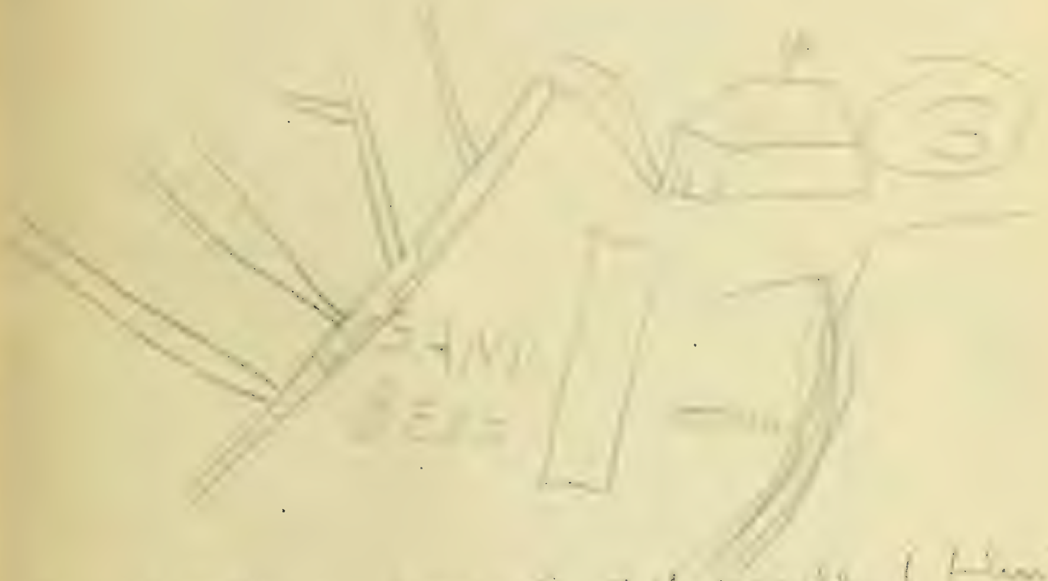
Type three
By Blonda Swaney
Group B (oral-chart)
Eighth grade.

B,
Blonda Swaney Group B oral chart 8th grade

Type four

Type 8

By Hubert Rena. Group C
(film) Seventh grade



By, Hubert Rena Group C 7th grade (film)

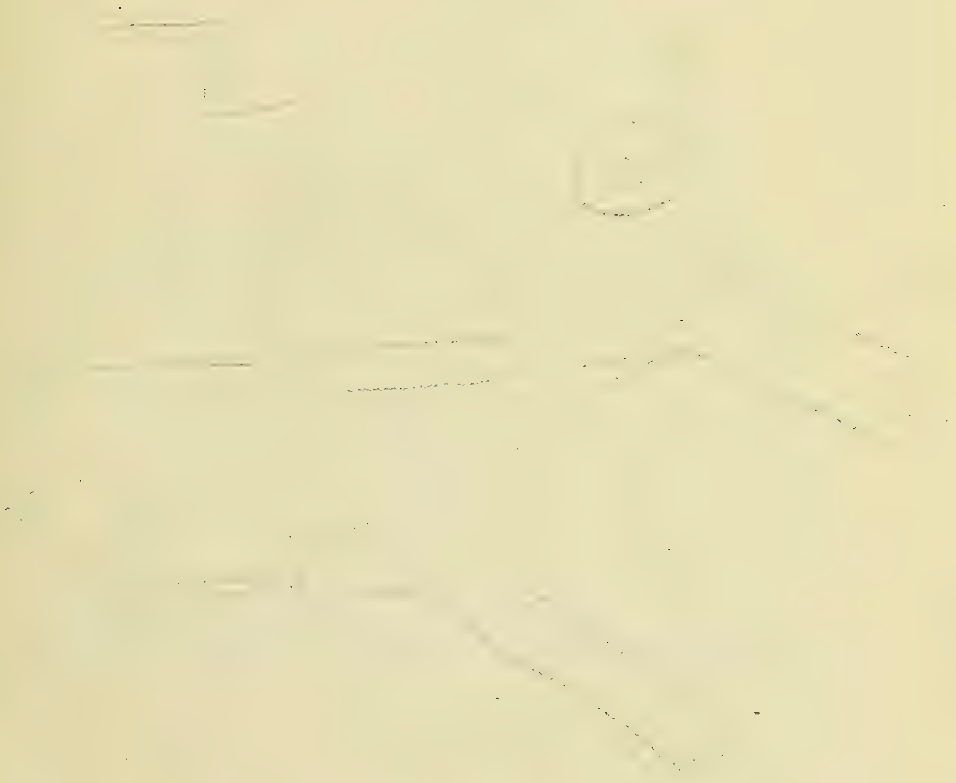
Type five
By Dorothy Herman Group
C (film) Eighth grade.

By Dorothy Herman
group C (film)
8th grade

Type six

Type 1

By Etta McDade Group C
(film) Eighth grade



Type seven

Type b

Type 3

By Dorothy Fletcher.
Group 6 (film) Eighth
Grade.

By Dorothy Fletcher (Group 6 (film) Grade 8)

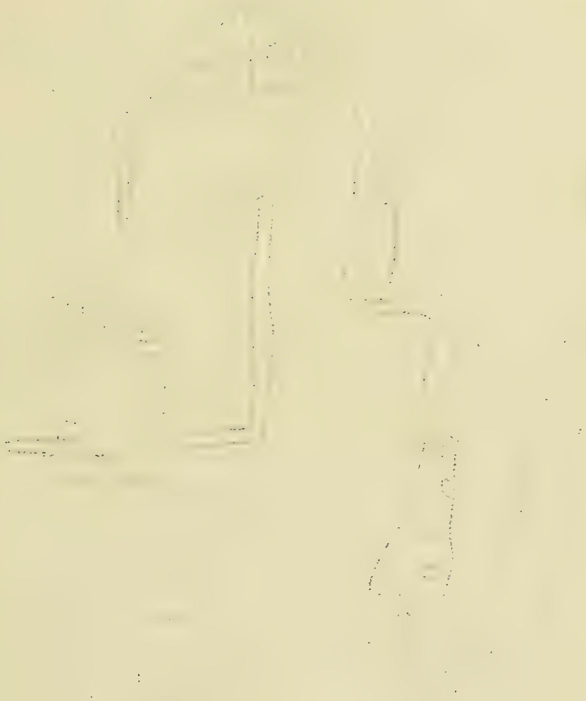
Type e

By Ira Hochstrasser.
Group D. (Oral-chart)
Eighth grade

By
Ira Hochstrasser, group D. oral-chart grade 8

Type d

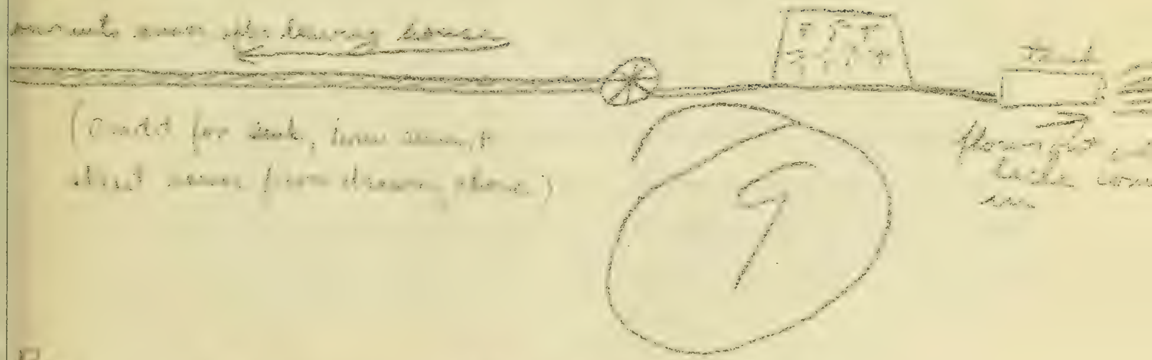
By Maynard Anderson.
Group D.(Oral-chart)
Seventh grade



Type f

By Arthur Willard
Group C (Film)
Seventh grade

Type h
By Edwin Martin
Group C (film)
Eighth grade



By
Edwin Martin. Group C (film) 8th grade.

Table sixteen shows the diagrams which can be enumerated under each classification, of errors

Grade	Group	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Blank-no response
7	C film	25	3	4	1	1	1	0	3
7	D oral+ chart	25	0	13	0	0	1	0	1
8	C film	34	4	10	1	4	0	4	2
8	D oral+ chart	34	0	23	0	0	0	0	0

Table 16. The classification of responses to question 23 enumerated according to the types listed on page .

made in response to question twenty three.

Table seventeen shows the responses which can be enumerated under each classification of errors made in response to question twenty four.

An examination of each type listed above reveals the fact that these classifications can be grouped under three larger headings. First, there are errors of omission and transposition of items in the sequence. Types one, two, three, a, b, c, d, e and f fall into this larger clas-

Grade	Group	Type a	Type b	Type c	Type d	Type e	Type f	Type g	Type h	Type i	Type j	Blank no respons
7	C. film	25	4	0	1	0	5	3	3	0	0	6
7	D. oral chart	25	2	2	4	5	0	0	0	0	0	4
8	C. film	34	2	0	3	1	0	4	6	2	4	5
8	D. oral chart	34	1	4	2	1	0	1	0	1	0	3

Table 17. The classification of responses to question 14 enumerated according to the types of error listed on page .

sification and for descriptive purposes these errors will be called "sequential errors." Second, there are errors of broken sequence or disconnected responses. Types four, five, six, g, h, and i fall into this larger classification and will be termed "disconnected errors." The third larger classification includes types seven and j, and in the fourth place we will enumerate the blank papers turned in by the pupils in each group.

A study of the classification of errors made in the responses to questions 13 and 24 shows that the seventh grade oral-chart group turned in 26 responses which contained sequential errors. That is 26 out of 50 diagrams turned in by the oral-chart group contained "sequential errors" while 17 out of 50 diagrams turned in by the film group contained similar errors. In the eighth grade the same relationship holds the ratio being 31 for the oral-chart group to 20 for the film group out of 68 diagrams submitted. (See table 18.) These figures represent a lack of completeness only in the diagrams enumerated under sequential errors whereas the diagrams listed under "disconnected errors" were not only incomplete but lacked unity of sequence as well and represent a mixed conception of the two methods of waste

disposal. That is, the "disconnected errors" reflect the failure of the two teaching methods to connect in the minds of these individuals the steps in the methods of waste disposals.

Table 18 shows that the seventh grade film group turned in twelve papers containing disconnected errors while there was only one such paper in the oral-chart group. In the eighth grade the film group produced charts seventeen of which contained disconnected errors as contrasted with two such errors in the oral-chart group. In other words, 24.58 per cent of the diagrams turned in by the two film groups contained disconnected errors while 2.54 per cent of the diagrams of the oral-chart groups revealed similar errors. (Note. In figuring these per cents blank papers were counted as diagrams.)

This fact would indicate that this film failed to connect in the mind of the child the information it contained as well as the teacher situation did. This result is similar to the results obtained from a study of the map responses in experiments one, two, four and five.

The larger classification three shows eight drawings in the eighth grade film group which were of the "crooked line type." These were the only diagrams of that type found. In the two film groups sixteen

Grade	Group	Sequential errors	Disconnected errors	Types 7and j	Blank
7	C. film	17	12	0	9
7	D. oral-chart	26	1	0	5
8	C. film	20	17	8	7
8	D. oral-chart	31	2	0	3

Table 18. The classification of the responses to question 23 and 24 enumerated according to "sequential errors","disconnected errors", Types 7 and j, and "Blanks."

papers were turned in with nothing on them while eight of the oral chart group papers were blank, a ratio of two to one.

A further analysis of the responses to the tests used in experiment seven was made in terms of the incorrect answers to certain questions in the question test.

The number of correct answers to questions one to twenty-two inclusive were tabulated by groups for each grade. Where ever it was found that the number of correct answers to a certain question was predominately larger in one group than in another for both grades the incorrect responses for that question were listed for both groups and compared.

Table 19 shows the tabulation of the number of accepted answers per question, per group, per grade. By finding the algebraic differences between the number of accepted responses made by the two groups in each grade and comparing these difference s grade for grade it was found that the film group surpassed the oral-chart group in each grade in question eight, fourteen, and twenty, and that the oral-chart group surpassed the film group in each grade in questions three, ten, eleven, twelve, and sixteen.

With this as a basis the incorrect responses

Number of uestion		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
I oral-chart	Grade 7	105	22	22	17	17	16	16	12	10	18	18	6	9	14	12	16	14	15	15	12	16	[illegible]
C film	7	83	12	20	14	15	16	11	16	9	9	5	5	10	17	12	15	16	10	4	13	17	23
Algebraic difference between groups (I- C)		-22	+1	-2	+1	+1	0	-5	4	-1	-9	-13	-1	+1	+3	0	-3	+2	+5	11	+1	-1	1
Group I oral-chart	8	120	34	[illegible]	16	20	22	19	22	12	21	21	20	16	[illegible]	[illegible]	[illegible]	11	30	9	22	17	32
C film	8	130	32	26	25	18	24	20	16	21	20	7	5	15	29	18	27	22	26	10	25	20	28
Algebraic difference between groups (I- C)		+10	-2	-7	-1	-2	+2	+1	[illegible]	+9	-11	-14	-15	-5	[illegible]	[illegible]	-5	-9	-4	+1	-3	+3	-4

Table 19. The number of accepted responses per uestion made by each group.

made in each group to question three, eight, ten, eleven, twelve, fourteen, and sixteen were listed. These questions were selected because of the consistancy of the performance of the four groups on those questions. Question twenty was not considered because the difference was so small.

The list of incorrect responses made by each group in answering questions three, eight, ten, eleven, twelve, fourteen, and sixteen follow.

Question 3. Where does it go next?

Correct answer:- To street sewer.

List of incorrect responses---Group C, Eighth grade. (Film)

1. It goes to the bay or ocean.
2. Down to the purification place.
3. Into the ocean, river or brook.
4. Goes into the lake or ocean if close by one.
5. It goes to the Boston sewage two miles away.
6. Carried out into the ocean.

Group C Seventh grade. (Film)

1. It goes to the sand beds.
2. Then it goes thru the sewer to the city.
3. Then to the purifier tank.
4. To the river or lake.
5. To the river.

Responses; 2 and 5 in the eighth grade and 1, 3, 4 and 5 in the seventh grade reflect the lack of a unified or connected understanding of the steps in purification for the Boston scheme, these responses being mixed with the Brockton scheme. The eighth grade response 5 is the best example of such a lack of unified understanding.

Question 3. Where does it go next?

Correct answer:- To street sewer.

List of incorrect responses---Group C. Eighth grade.
(Oral-chart)

1. To harbor.

Group D Seventh grade. (Oral-chart)

1. It goes into the sewage in the streets.
2. Then it goes to lakes, rivers or oceans.
3. Harbor.

None of the responses above with the possible exception of 2 in the seventh grade are hazy.

Question 8. By what means is the sewage of the city of Brockton sent away?

Accepted answer: By machinery, pumps, large pipes.

Group C Eighth grade. (Film)

1. It flows to the collective sewer.
2. Purified
3. Large sewer
4. By stream
5. In a brook
6. In large tanks
7. By tanks
8. Electric filter
9. Stream

Group C Seventh grade. (Film)

1. Blank (1)
2. Tide
3. Electricity
4. Thru sewers
5. By a brook
6. Purifies
7. By steam
8. By large sewer
9. To purafie town

One response number 2, seventh grade, is mixed with the Boston scheme. The remaining responses are like

those in the oral-chart groups representative of a misunderstanding of the question itself. The film was more effective in teaching the use of the pump in the Brockton scheme than the oral-chart method.

Question 8. By what means is the sewage of the city of Brockton sent away?

Accepted answer: By machinery, pumps, large pipes.

Group D Eighth grade. (Oral-chart)

1. Stream
2. Blank (4)
3. By the street sewers
4. Harbor
5. To a bed of rock
6. Main (?)
7. By means of sewage system
8. In a "crick"
9. Eaten by microbe, water "flees", fish.

Group C Seventh grade (Oral-chart)

1. Blank (6)
2. By water
3. Poured into a stream
4. As water
5. Over sand
6. By a stream
7. To get germs out
8. By a stream

Responses 4, and 9 seventh grade are confused with other steps in the process in a large fashion, response 4 being confused with the Boston scheme.

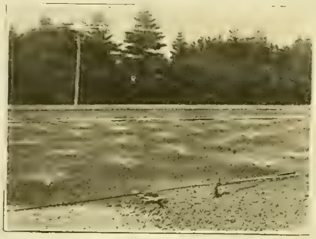
Response 1, and 8, in the seventh grade and 1, 3, 6, and 8 in the eighth grade are answers which are in part correct except for the fact that the question did not call for the last step in the Brockton scheme thru its position.

Question 10. Where it is sprayed upon a----.

Accepted answer: Rock bed, or crushed rock bed.

Group C Eighth grade. (Film)

1. River
2. Lake or ocean
3. Blank (4)
4. Field
5. Rocky sand
6. Low piece of ground
7. Sand purifier
8. Sand bed (2)
9. Field of sand
10. A layer or filter



The rock bed.

Compare responses 1,4,5,6,8 and 9 of the eighth grade and 1,2,3,5, and 6 of the seventh grade with this picture. Where are the "rocks" in the picture? This is the picture these pupils saw in the film.

Group C Seventh grade. (Film)

1. Sand bar
2. Sand bed (7)
3. Sand bank and in a river
4. Blank (3)
5. Sand bank
6. Clod field
7. Trickling sewer

The responses listed above are largely errors in sequence.

Question 10. There it is sprayed upon a----.

Accepted answer: Rock bed, or crushed rock bed.

Group D Eighth grade. (Oral-chart)

1. Thru tiles to stream
2. Rock bed at Boston
3. Screen- near the power wheel

Group D Seventh grade. (Oral-chart)

1. Blank (5)
2. Sand bed
3. Lawn and into another pipe

Responses 2, eighth grade is confused with the Boston scheme. The remainder are errors similar to those in the film group. Fourty nine of the oral-chart groups wrote acceptable answers to this question as compared to twenty nine in the film groups.

Question 11. How is the harmful organic matter converted into harmless minerals?

Accepted answer: By bacteria, by the action of bacteria, or bacteria feed on it.

Group 3 Eighth grade. (Film)

1. Blank (5)
2. By spraying
3. Rock beds, sand beds, long distance flowing in creek.
4. By passing thru stones, and filter, and bed of sand.
5. It is purified and then liquid minerals is in it.
6. It runs into some sand and leaves the harmful organic matter.
7. When it flows over the rocks.
8. Sent into some more rock beds and into sand beds.
9. By being spraid on rocks.
10. Eat on the sewage and grows.
11. It is eaten up by fish and tadpoles and other things.
12. They mix them up.
13. By the sand.
14. Sprayed upon a bed of rocks then a bed of sand and flows into brook.
15. By passing thru beds of sand and being purified.
16. By flowing upon the sand beds.
17. Purification.
18. Thru sand mills and the brook.

19. By letting the sewage sink thru sand.
20. By being sprayed on rocks and they stick to the rocks.
21. Running over sand, rocky, gravel and dirt.
22. It is gone thru many processe
23. The gravel and sand is covered with bacteria.

Group C Seventh grade. (Film)

1. By the stream that it flows into.
2. Blank (9)
3. The organic matter is converted into harmless minerals.
4. It dissolves into rock and sand.
5. By running thru sand beds.
6. By flowing over rocks and thru sand beds.
7. It is run thru a sort of machine.
8. It collects upon this dirt.
9. By testing
10. Passing thru sand and into a brook.
11. By putting sewage on rocks and being sprayed.
12. By means of brocken rock, sand and crushed rock.

The responses from the film groups not accepted to question eleven show in every case that the process was not clearly understood. The pupils were unable to grasp the importance of the bacterial action from the film's presentation even tho the film stressed this point going so

far as to show miscroscopic slides of bacteria. Twenty-three per cent of the pupils in the film groups did not even attempt ot answer the question.

Question 11. How is the harmful organic matter converted into harmless minerals?

Accepted answer: By bacteria, by the action of bacteria, or bacteria feed on it.

Group D Eighth grade (Oral-chart)

1. It goes thru the "strays" at the rock bed.
2. By means of drainage systems.
3. When they reach the stone bed.
4. By the stones and the sand and pumps.
5. By settling on the rocks and eating the waste "maters".
6. The matter is sprayed upon the rocks.
7. The water fleas eat it first, then the fish eat it.
8. It is put thru the sand bed and rock bed.
9. These harmful organic matters go thru a filter.
10. It is eaten by the fish.
11. They are converted by-----
12. It falls on the rock and the rock makes it minerals.
13. By---------
14. Blank (1)

Group 3 Seventh grade (Oral-chart)

1. Blank(1)
2. By rocks and sand and spraying.
3. It runs thru broken rocks and stays in the rock beds.
4. All of the little animals and all of the rock.
5. Thrown over the rock bed and sand bed to the fish.
6. It flows into crushed rock beds the "froun" substance is taken out, then it goes thru a sand bed and becomes clear.
7. By different plants and animals in the water.
8.

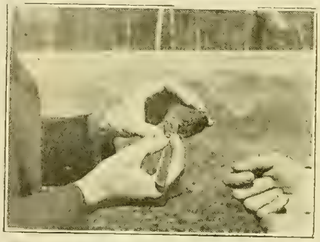
Responses 5, eighth grade and 4 seventh grade were close to the point. The remainder were confused. Thirty nine of the oral-chart groups wrote acceptable answers to this question as compared to twelve of the film groups.

Question 12. How do the rocks which are covered with these organisms look?

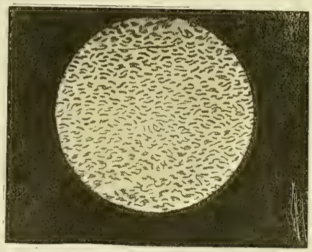
Accepted answer: Brown and slimy, black and dirty, a coating of jelly like substance.

Group C Eighth grade. (Film)

1. Full of the bacteria (2)
2. Blank (10)
3. Clean
4. Like germs
5. Routh
6. Pointed
7. Rich
8. Like showers
9. Like worms
10. White
11. Black spots
12. Dirty (2)
13. Black (3)
14. Foamey
15. Like an ants nest
16. Irregular
17. With much bacteria



The rock covered with organisms.



Bacteria under the microscope.

Pictures one and two are the pictures from which the film group drew its information for the responses listed above. Responses 9 and 15 in the eighth grade indicate what picture 2 meant to those pupils.

Group C Seventh grade. (Film)

1. Blank (8)
2. Coal (4)
3. Black (3)
4. A big lump of sugar brown.
5. Has it all over
6. They look like small worms
7. Dirty (1)
8. Covered with black

The incorrect responses recorded in answer to question twelve by the film groups are very interesting. The film showed a close up picture of a man holding one of the rocks while he scraped the slimy, dirty, layer of bacteria off it. The rock looked black in the picture, like a piece of coal but the meaning which was supposed to be gained from that close up illustration failed to go across to the pupils. Only seventeen per cent of the film groups wrote acceptable answers as compared to forty four per cent of correct responses in the oral-chart groups. Thirty per cent of the film group did not even attempt to answer the question.

Twenty two of the incorrect responses by the film groups to question twelve were descriptive terms which would apply to any dark rock about the size of your fist, such as, rough, pointed, irregular, black, coal, black spots, dirty and so on.

Question 12. How do the rocks which are covered with these organisms look?

Accepted answer: Brown and slimy, black and dirty, a coating of jelly like substance.

Group D Eighth grade. (Oral-chart)

1. "Bactera"
2. Jorey
3. Blank (3)
4. Like bacteria
5. Germs
6. Little insects
7. A little flower on a stem
8. All kinds of shapes
9. Different shapes
10. Big rocks
11. Stone beds
12. Blue

Group D Seventh grade. (Oral-chart)

1. Like a----
2. Blank (9)
3. Like rocks
4. A brownish color
5. Like a fist and sprays
6. Rather large
7. Brown, about the size of your fist.
8. Spray of water
9. They look like sprays
10. Brown
11. Some are curly and some are curved.

The incorrect responses of the oral-chart groups to question twelve were either descriptive of any dark colored stone about the size of your fist, or were mixed up with a description of the sprays and the bacteria themselves. Fourty four per cent of the oral-chart group wrote acceptable answers. Twenty seven per cent did not attempt to answer the question.

These rocks were described in the lecture as being about the size of your fist and covered with a brownish black slimy or jelly like substance.

Question 14. Then the sewage flows upon ----.

Accepted answer:- Sand beds.

Group C Eighth grade. (Film)

1. Blank (1)
2. The river
3. Rocks
4. Rocks
5. Water--then thru a shower

Group C Seventh grade. (Film)

1. A bank and out into the stream
2. Blank (5)
3. A tank
4. A concrete way
5. Beds of small rocks

The errors made in answering question 14 by both the oral-chart and film groups are of the same general type. The film seemed to be more effective in teaching the place of the sand beds in the process than the lecture.

Question 14. Then the sewage flows upon ----.

Accepted answer:- Sand beds.

Group D Eighth grade. (Oral-chart)

1. Waste bed
2. Rock bed, then into settling tank.
3. A settling tank
4. The rock and sand thru pipes.
5. It drains thru the rock, then thru the sand.
6. Tank
7. Rock bed
8. The rock bed, it is sprayed onto rocks.
9. Rock bed--It is made into mineral by bacteria.
10. The broken stones--It is sprayed upward.
11. A"seteline" tank.

Group C Seventh grade. (Oral-chart)

1. Blank (6)
2. The pump, the rock bed.
3. Water--or
4. The rocks (2)
5. Stone bed.

Question 16. How does the sewage look when it leaves here?

Accepted answer:- Clear, or like pure water.

Group C Eighth grade. (Film)

1. Blank (3)
2. One mass of liquid.
3. Sand
4. Much cleaner.
5. Foamy

Group C Seventh grade. (Film)

1. Blank (5)
2. The sewage looks dirty and foamy.
3. Partly clean.
4. There is white foam on it.
5. Unpurified.
6. Foamy with little things.

Responses: 5 eighth grade, and 2, 4 and 6, seventh grade, by the film groups describe what was in the close up picture of the water flowing out of the pipe from the sand beds into the brook. It was clear with foam on it here and there. The real concept of clear water which was the purpose of the close up in the film failed

to go across to these four children. This is similar to the results obtained from studying the errors in question twelve.

Question 16. How does the sewage look when it leaves here?

Accepted answer:- Clear, or like pure water.

Group D Eighth grade (Oral-chart)

1. All little insects.
2. Like water and weeds.

Group C Seventh grade (Oral-chart)

1. Blank (1)
2. It looks like small animals.
3. It looks harmful.
4. Wastes
5. It looks brown.
6. It looks dirty.
7. It looks purer than before.

The oral-chart groups made eight more correct responses to this question 16, than the film groups. Only one pupil in the oral-chart groups failed to attempt any answer while eight pupils in the film groups wrote nothing in answer to this question.

The analysis of errors made by both groups in the original question and chart tests shows certain limitations of this film as a teaching unit in and of itself. These limitations will be discussed in the conclusions, The analysis was not carried into the memory tests since it would prove to be largely a repitition of the material above. However, such a study would be valuable in showing what particular information proved to be the most permanent as a result of the different forms of presentation.

The composition tests are not discussed here further than to show the score made by each group. The writer feels that the composition test as a spontaneous test failed to function in experiment seven.

CHAPTER VIII

Experiment 8.

PROBLEM. Three comparisons were made in experiment eight. First, one projection of the film was compared with an oral lecture using pictures copied from the film. Second, the film was compared with a showing of the same film during which oral instruction was given. Third, the latter method was compared with the oral lecture. How effective were these three methods of presentation in "putting across" to the pupils the information contained in the unit of subject matter? This is the question which experiment eight attempted to answer.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The subjects selected for experiment eight were groups A, C, and D of the eighth grade Thornburn school. The groups were rotated so that methods of instruction different from those used in experiments six and seven would be applied to each group.

(2) Topic. The topic selected for experiment eight was the same as that used in experiment three,

namely, "The History of the Monarch Butterfly." The film was produced by the Society for Visual Education, Incorporated. The selection of this topic was not by choice. The writer had planned to use the film entitled, "The Mosquito", but found that the Society for Visual Education was unable to supply the film at the desired time.

The oral material used in experiment eight followed the same outline used in experiment three. Instead of the slides used in experiment three, the writer copied charts from the film by projecting the desired picture on a card-board 24x30 inches.

(3) Presentation of the topic. On December 6, 1921, group C, eighth grade, Thornburn school, was assembled in the geography class-room, which was used for the projection room. (See above page 127.)

They were given the following instructions;

> "Today you will learn something of the story of the life history of the Monarch butterfly. First you will hear a part of the story read to you, then you will hear the teacher tell the story in detail. Pay attention to everything you see or hear, for you will be given a test to find out what you have learned."

A three-minute discussion of the history of the Monarch butterfly was read to the group. This discussion was the same as that used in experiment three.

Following this three-minute discussion the teacher gave an informal detailed talk to the pupils on the topic, using for an outline the three minute discussion above. During the talk the teacher referred from time to time to the six charts copied from the film. This talk lasted twelve minutes, timed by the teacher's watch.

The outline of the oral material is the same as that used in experiment three, and a comparison of it and the film outline shows it to be copied direct from the film's story.

The charts which were used are inserted at this point. These charts will serve to give an idea to the reader of the material in the film and fortunately can be compared directly with that material by referring to the illustrations taken from the film shown in chapter three, pages [illegible]
.

CHARTS COPIED FROM THE FILM. SMALL CUTS ARE INSERTED WHERE AVAILABLE TO SHOW THE ORIGINAL PICTURE AS COMPARED WITH THE COPY

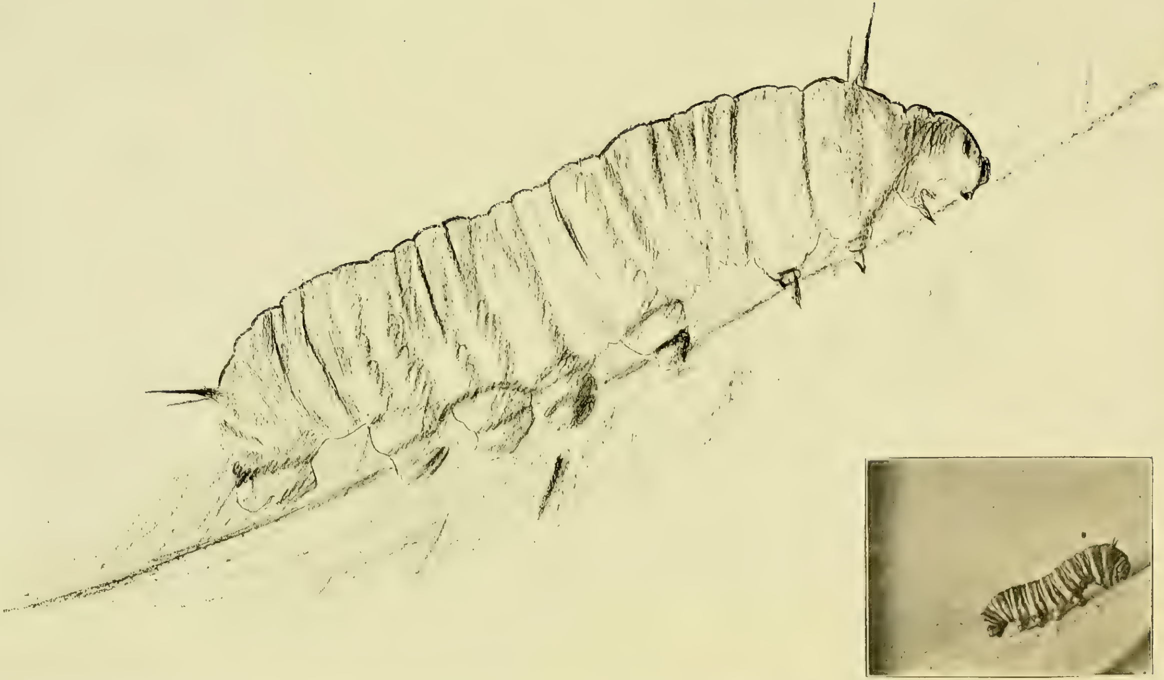


Chart 6. The larva on the milkweed leaf. Small cut is taken from film.

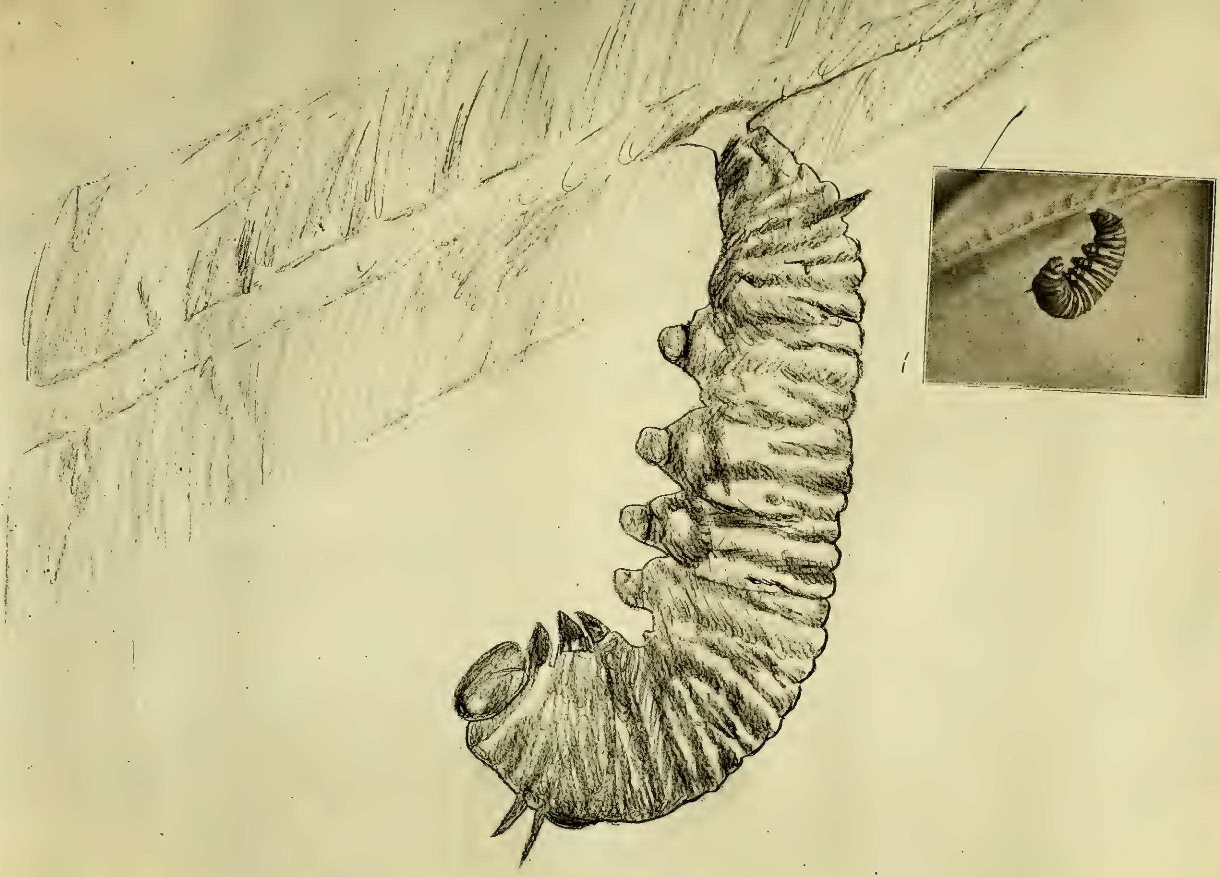


Chart 7. Larva hanging from leaf. Cut taken from film show. larva before it has straightened out.

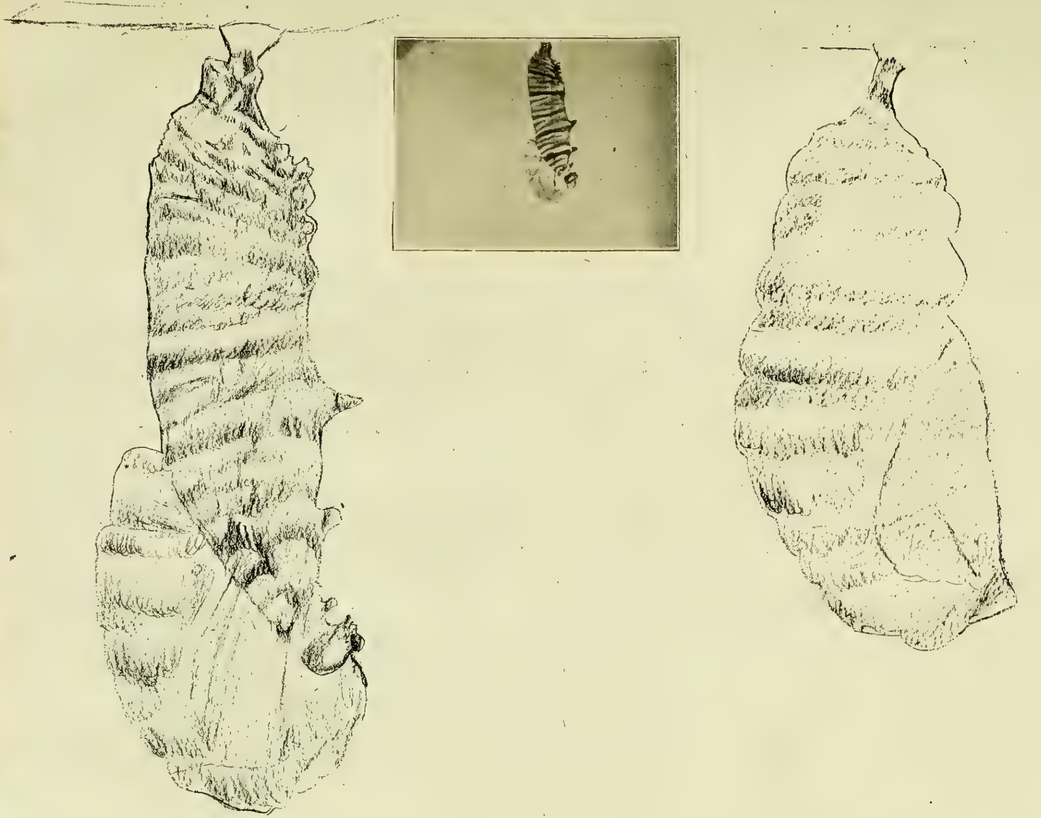


Chart 6. Larva bursting skin at left. The chrysalis at right. Small cut from film.

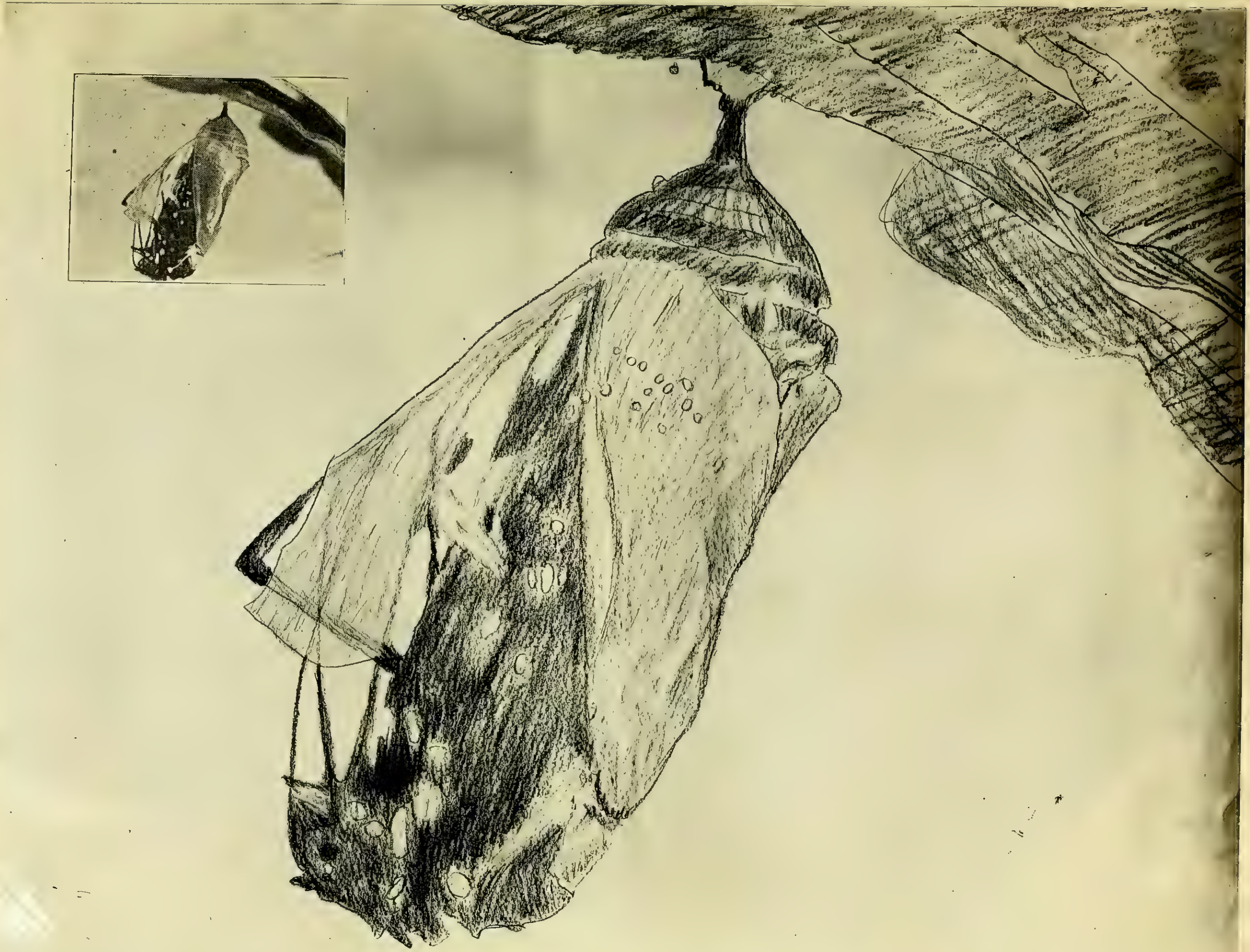


Chart 9. Butterfly emerging from chrysalis. Small cut taken from film.

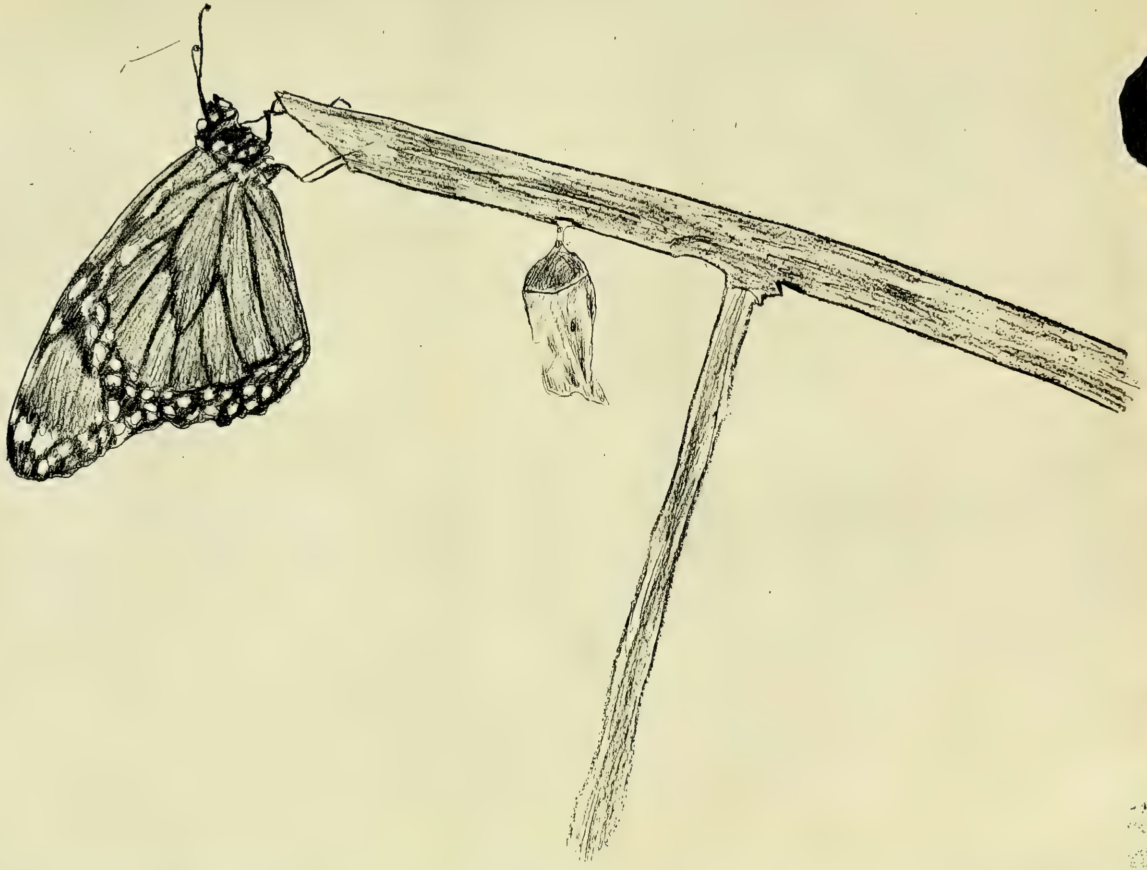


Chart 10. Butterfly climbs on branch to rest and exercise its wings.

Chart 11. Spicules at left highly magnified. Monarch at right.

As soon as the oral instruction was completed the group was given a two-fold test.

Group D was assembled in the geography class-room as soon as the test was finished by group C.

Group D received the following instructions: --

> "Today you will learn something of the story of the life history of the Monarch butterfly. First you will see a film which will tell the story in detail. Pay attention to everything you see or hear, for you will be given a test to find out what you have learned."

The three minute discussion of the life history of the Monarch butterfly was read to the group. This discussion was the same one used with group D.

Following the preliminary discussion the film was shown. The projection lasted twelve minutes.

For an illustrated copy of the film outline see chapter three.

At the end of the instruction period the group was given a two fold test.

Group A was assembled on December, 7th, the following morning, in the geography class-room and were given the following instructions;-

> "This morning you will learn something of the story of the life history of the Monarch butterfly. First you will hear a part of the story read to you then you will see a film which will tell the story in detail. During the showing of the film you will be given an oral explanation of the story to aid your understanding of the film. Pay attention to everything you see or hear for you will be given a test to find out what you have learned."

The three minute discussion of the life history of the Monarch butterfly was read to the group. This discussion was the same one used with groups C andD.

Following the preliminary discussion the film was shown accompanied by explanatory remarks by the teacher who gave the oral instruction to group C. This presentation lasted twelve minutes.

(4) The tests. The groups were given a two fold test at the close of each period of instruction. First they were asked to write a composition on the life

history of the Monarch butterfly. Second, they were asked to answer a set of mimeographed questions. The composition represents a spontaneous reaction to the unit of instruction, while the question test is representative of a controlled reaction. The instructions given each group before starting the tests were as follows: --

> "On the top of your blank sheet of paper, first write your name, grade, and home teacher. Then write a story about the life history of the Monarch butterfly. Write just as much as you can remember of what you have seen and heard. As soon as you have finished your composition raise your hand and turn your paper face down on your desk. I will bring you a set of questions which I wish you would answer also. Fill in the blank spaces and answer as many of the questions as you can. When you are through fold your paper in the middle and bring it to me."

The question test was the same as that used in experiment three. For a sample of the questions and answer key see pages 71-74.

The papers were all scored by the writer's assistants, one assistant scoring the question tests which were checked by another assistant and the writer eight weeks later. The composition tests were scored by the same assistant who scored the compositions in experiment seven. This assistant, Miss Hilgard, had been carefully trained by the writer for this work and she checked her scoring sixteen weeks later. Each correct idea reproduced was scored one point. The memory test was given Feb. 20, 1922.

RESULTS. The average scores made by each group in experiment eight are shown in table twenty.

Original test. December 6, 1921.

Group	Grade	No. pupils	average chronological age in years	average intelligence test score	average intelligence quotient	average question score	% loss	M I	composition score	% loss	M I	average total score	% loss	M I
A-film & talk	8	30	13.60	97.78	108.5	12.13		1.74	20.80		3.81	32.93		4.80
C-oral chart	8	30	13.51	97.12	110.70	10.57		2.43	21.57		5.94	32.15		7.68
I-film	8	30	13.71	97.78	107.9	10.40		1.99	14.43		4.67	16.83		6.00
Memory test			Feb. 20, 1922				% loss			% loss			% loss	
A-film & talk	8	30	13.80	97.78	108.5	5.50	55	2.63	6.40	70	2.69	11.90	64	4.54
C-oral chart	8	30	13.51	97.12	110.70	4.20	60	2.72	4.95	77	3.97	9.02	72	5.00
I- film	8	30	13.71	97.78	107.9	3.10	71	2.13	4.50	67	2.53	5.60	68	4.16

Table 20. The scores made by the pupils in experiment eight on the originaltests and the memory test.

The rank of the three groups in terms of the average question score is, first the film-talk group "A", second the oral-chart group "C", and third the film group "D". (In experiment seven group D was the oral-chart group which made an average score much higher than the film group "C". The personnel of these groups was the same in both experiments with the exception of four pupils, who were absent, in each group. Group "A" was the film group in experiment six which made a slightly higher score than the film-talk group "B", which was not used in experiment eight.)

The rank of the three groups in terms of the composition test is, first the oral-chart group "C", second the film-talk group "A", and third the film group "D". In the total score the film-talk group "A" is .80 points or 2.4% higher than the oral-chart group "C", which is in turn 5.30 points or 19.7% higher than the film group "D".

To return to the consideration of the question score, we find that the film-talk group made an average score 16 per cent higher than the film group. This result is contrary to the statement commonly made by film enthusiasts, that it is psychologically wrong to talk to a group while a film is being shown.

The film-talk group also was 14 per cent higher than the oral-chart group in the question score. This result reflects in part the advantage of the film itself over the charts or pictures copied from the film in black and white. The teacher in both groups was the same.

The composition score shows a slight superiority of the oral-chart group over the film-talk group of 5 per cent. However, the difference between these two groups and the film group is very striking. The oral-chart group was 31 per cent higher, and the film-talk group was 26 per cent higher than the film group in the composition test.

The memory test residual score for the film group is higher by .57 points or 11.5% than the oral-chart group in the composition test, but .90 points or 16.5% lower than the film-talk group. This result is interesting in view of the large difference between the film group and the other two groups in the original composition test.

The residual scores made by the three groups in the question test ranks the film-talk group first, the oral-chart group second, and the film group third, with a difference of 1.20 points or 27.9%, and 1.80 points or 38.7% between the groups in the order named. The same relationship holds for the three groups in the residual total score. The

film-talk group being 2.88 points or 31.9% higher than the oral-chart group which is in turn .42 points or 4.8% higher than the film group.

The memory test scores indicate a distinct advantage for the film-talk method over the other two methods as far as the amount retained is concerned.

The per cent of loss for each group varies for the three scores. In the question test the film group has the highest per cent of loss, with the oral group second and the film-talk group third. The highest per cent of loss in the composition test is shown by the oral-chart group with the film-talk group second, and the film group third with a per cent 10 points lower than the oral-chart group. The highest per cent of loss in the total score is likewise shown by the oral-chart group. The film group, however, is second and the film-talk group shows the lowest per cent of loss by 4 per cent. In none of the three scores does the oral-chart group show the lowest per cent of loss. In each instance a group which had seen the film recorded the lowest per cent of loss. In other words, the group receiving the largest amount of oral instruction shows the greatest per cent of loss taking the experiment as a whole.

This result is similar to the one obtained in experiment seven.

In order to check the validity of the tests themselves in terms of the previous knowledge of the pupils of the life history of the Monarch butterfly thirty-seven pupils of the eight grade group B were given the two fold test at the same time the memory test was given to groups A, C, and D.

They were instructed as follows;-

> "Today I am going to give you a test on the life history of the Monarch butterfly. You have not heard this story nor have you seen the film by that title. First I want you to write a composition on the life history of the Monarch butterfly, as soon as you have finished turn your paper over on the desk and answer as many of the questions on the second sheet as you can. Do not look at the questions until you have finished your compositions. Before starting the test write your name, grade and home teacher at the top of each sheet."

These papers were scored along with the memory test papers and showed the following results:-

	average question score	average composition score	average total score	average Intelligence score	average I.Q.	average age
Group B No Instruction 8th grade	.64	1.73	2.37	92.31	107.6	14.10

Table 20A. The results of giving the "butterfly test" to thirty-seven uninstructed eighth grade pupils.

By finding the per cent each score in table twenty-~~one~~A is of the average of the average question, composition and total original scores for the three groups we find the per cent of each score which can be attributed to previous knowledge. Thus we find that 5.5 per cent of the original question score, 5.2 per cent of the original composition score and 2 per cent of the total score may be attributed to knowledge of the life history of the Monarch butterfly which the pupil possessed previous to experiment eight.

While these percents are not small enough to be neglected they show that the answers to the question test used in experiment eight 94.5 % dependent on the instruction received as far as these eight grade pupils were concerned.

CHAPTER IX.

Experiment 9.

PROBLEM. The deeper one digs his way into a research problem, the more refined his technique of procedure becomes, and the more critical he is of his own digging. Progress seems to be increasingly slower. It takes longer to hoist the shovel full of ore to the surface for an evaluation.

The first eight experiments led the experimenter to waste no effort in his attempts to duplicate the film situation in the teacher situation as closely as possible. This desire was realized in the happy selection of a film wherein a well known geographer was shown giving an illustrated chalk talk. The writer practiced the same chalk talk, and then selected two groups from each of the seventh and eighth grades to be taught by the two methods. The comparison made therefore was one between the amount of information taught by the film and that taught by the writer's duplicating chalk-talk, to the pupils of the groups named.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The pupils selected to act as subjects in experiment nine were the members of groups B and C, eighth grade, and groups C and D, seventh grade, Thornburn School.

(2) Topic. Several films were under consideration for experiment nine, but few permitted of the type of comparison which the writer desired to make. Finally, "The Story of a Mountain Glacier" was decided upon, since the film was a moving picture of Mr. Atwood giving a blackboard chalk talk on this subject. The captions served to supply the lack of the spoken word, and still scenes of glaciers were interspersed throughout the film in the capacity of additional illustrative material. One scene of floating icebergs represented the only action picture in the film outside of Mr. Atwood's actions.

The writer duplicated this material by copying two charts from Mr. Atwood's drawings, and by practicing on the other chalk sketches until he was able to reproduce them in a fairly accurate and rapid manner. The pictorial material was illustrated and described verbally as the talk progressed.

(3) The presentation of the topic. Group B, eighth grade was assembled in the geography classroom on

December 13, 1921, and received the following instructions:--

> To-day I am going to tell you the "Story of a Mountain Glacier." How many know what a glacier is? (Show of hands) Pay strict attention to all you see and hear, for you will be given a test at the end of the period to find out how much you have learned about mountain glaciers."

The writer then talked to the group for thirteen minutes, using the front blackboard for his sketches and charts. A stenographer was present during the oral instruction period, and took a report of the writer's verbal instruction. (The stenographer misunderstood directions and failed to make a strictly verbatim record of the oral instruction.)

The stenographer's record of the oral instruction is as follows:--

Mountain Glaciers

> This morning we are going to make a study of Mountain Glaciers. It is a big accumulation of snow high up in the mountains. This snow is so heavy that it presses the lower layers of the snow into ice and in this fashion a glacier is formed. (Board). Snowball--Example.
>
> There are certain features in a glacier which we must study in detail. For example, a glacier consists of such a big portion of ice that it often begins to crack and this

crack is called a crevasse. Sometimes these crevasses are two or three hundred feet deep.

Along with the glacier is often a big accumulation of rocks and gravel. This accumulation moves along with the glacier and forms a morain. (Board).

(There are three moraines to be discussed. Lateral, Medial, and Terminal.)

When a morain is formed at the side of a glacier, it is called a Lateral Morain.

A Medial Morain is formed by the union of two lateral morains.

A Terminal Morain is formed by the accumulation of rocks and gravel at the extremity of the glacier. If a tree is in the way when the glacier moves along the accumulations often are stopped by the tree, but there is no particular name for this.

As the glacier reaches the valley it pushes on toward the sea, and there it breaks off into large pieces of ice forming icebergs. (Example of sinking the Titanic.)

If the climate changes and we have several warm summers the glacier may be melted. (Board) This melting changes the shape of the glacier, making it no longer perpendicular in shape. (Board) After this melting all the accumulations of this glacier come down to the water's mouth and forms a delta.

Some glaciers never reach the sea at all because they are too far from the sea (Alps). They just reach the valley and melt and form a little stream or river which goes to the ocean.

> Glaciers are started very high up in the mountains and the moving of this glacier is determined by how steep the slope is in the first place, and how much snow there is to push it along. If we have a low mountain, it will not roll so fast. So you can see the progress of a glacier is very slow and it takes many years to reach the valley. Each year there are new accumulations of snow, thus making it almost permanent.
>
> Pupils: Remember about the morains and their definitions.

An examination of this stenographic report indicates that the writer's oral instruction could have been improved in several places. Were the writer to repeat this experiment, he would write out carefully the exact wording of his statements, and then memorize the lecture.

Group C, eighth grade followed the chalk talk group B. The instructions given to group C were as follows:

> To-day I am going to show you a film which will tell you the story of a mountain glacier. How many know what a glacier is? (Show of hands). Pay strict attention to all you see, for you will be given a test at the end of the period to find out how much you have learned about mountain glaciers.

The film was then projected before the group, the time involved being thirteen minutes. An illustrated outline of the film follows:-

STUDY OF A MOUNTAIN GLACIER

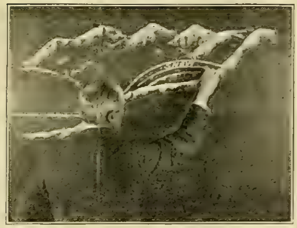


Figure 1
How a glacier begins

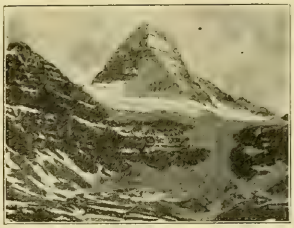


Figure 2
Snow gathers among the mountains

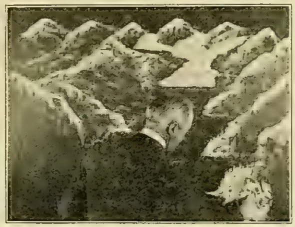


Figure 3
The young glacier moves slowly down the mountain valley

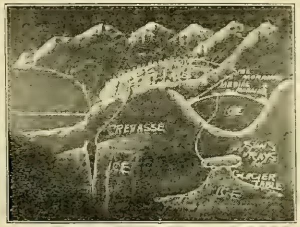


Figure 4
Falling stones form moraines

A SURVEY OF THE REEL

Purpose of the reel:
To depict fully the
process of glacial formation.

In this film Dr. W. W. Atwood—formerly Professor of Physiography at Harvard, now president of Clark University—gives a personal ''chalk talk'' in which we are told, chapter by chapter, the fascinating story of glaciers and icebergs, moraines and crevasses, ''ice tables'' and glacial rivers and valleys. Graphic diagrams picture cause and effect, with magnificent scenics to illustrate each point. Not the least interesting feature of the blackboard work is the fact that Dr. Atwood uses both hands with equal skill and rapidity.

The reel opens with motion pictures showing a glacier as it moves down between its mountain walls and meets the sea. Then to show us how a glacier is born, Dr. Atwood puts upon the blackboard a cross-section drawing of a glacier and its valley (Fig. 1). In this diagram he visualizes snow accumulating high among the mountains, and motion pictures supplement the blackboard explanation with scenes of lofty peaks and mountain snow fields (Fig. 2). Another chalk illustration pictures in perspective the snowy beginnings of the river of ice we call a glacier.

''The weight of the snow,'' explains a title, ''causes ice to form.'' This is indicated on Figure 1 by labeling the lower levels ''ICE.'' Moving pictures show us a parallel stage in glacier formation today. On the perspective diagram Dr. Atwood then pictures the gradual increase of glaciation, as the moving mass of ice makes its slow way down the mountain valley (Fig. 3). He shows in detail how a giant crack, called a crevasse, results where a glacier bends over a steep slope (Fig. 4). Motion pictures illustrate crevasses in actual glaciers.

Next we come to the story of moraines, those accumulations of gravel, stones,

rocks and boulders that, ages after the glacier has disappeared, still mark its path. Some of this debris the glacier plucks from its bed as it makes its rough-shod way along the valley; some of it rattles down from the mountain sides. This process is graphically indicated on the cross-section sketch, and detail drawings explain step by step the origin of each type of moraine—terminal, side and medial (Fig. 4). Here again moving pictures of actual moraines give concreteness to the sketches.

The cause of those curious formations called glacier tables, or "ice tables," is made clear in a detail drawing. A huge boulder, falling from the mountain side, lodges upon the ice. By and by, as the sun's rays melt the ice around and the boulder continues to protect the ice beneath, the rock stands perched upon a little peak of solid ice, like a table top upon a pedestal (Fig. 4).

When the glacier reaches the sea, the ends are buoyed up and broken off, forming icebergs that float away like drifting mountains (Fig. 5). With remarkable vividness the chalk sketch pictures the iceberg's relation to the glacier (Fig 6) and makes us realize that all but about one-eighth of the berg's mass is submerged. The drawings are again followed by moving pictures that give us the sensation of actually threading a perilous path among these gigantic, picturesque mountains of ice.

"In time," a title tells us, "the climate may grow warmer and the glacier be melted back." On the chalk perspective the glacier is erased back and the new appearance, due to melting, is drawn in. Dr. Atwood shows how the stream that flows from the melting glacier forms a delta at its outlet (Fig. 7). Glacial action has left a sheltered valley, which proves an ideal location for the little village that soon springs up—visualized for us by tiny houses drawn into the diagram. Glacial streams furnish power to run factories, and in time the village becomes a city.

The reel closes with a magnificent panorama of a glacier, of which Figure 8 shows us one interesting view.

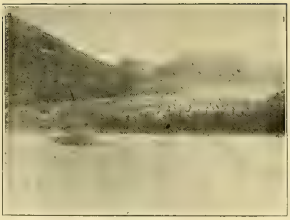


Figure 5
At the sea, icebergs break off

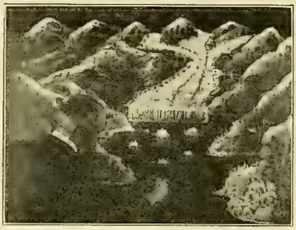


Figure 6
The floating berg is seven-eighths under water

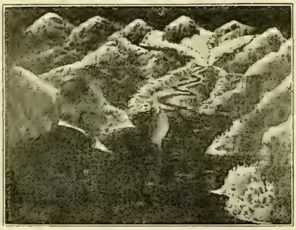


Figure 7
A river flows from the melting glacier and forms a delta

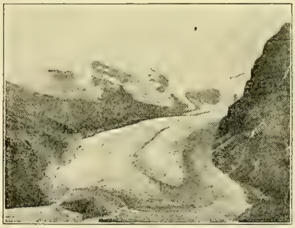


Figure 8
Panorama of a glacier

THE FOLLOWING CHARTS WERE COPIED FROM THE FILM AND WERE USED BY THOSE GIVING THE ORAL INSTRUCTION IN EXPERIMENTS NINE, TEN AND ELEVEN.

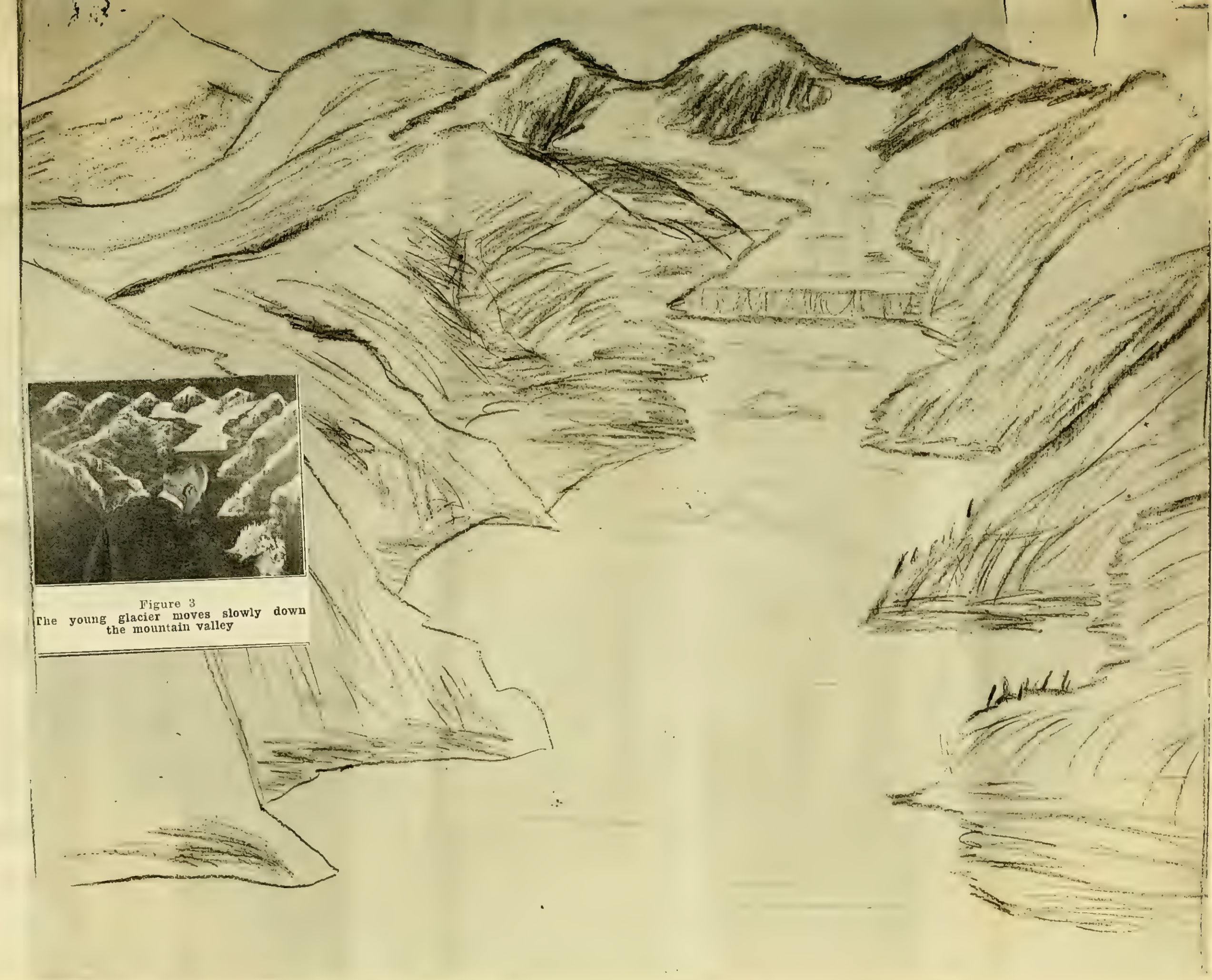


Figure 3
The young glacier moves slowly down the mountain valley

Chart 12. The glacier after reaching the sea breaks off into Icebergs.

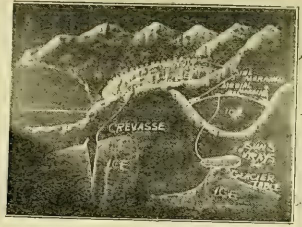


Figure 4
Falling stones form moraines

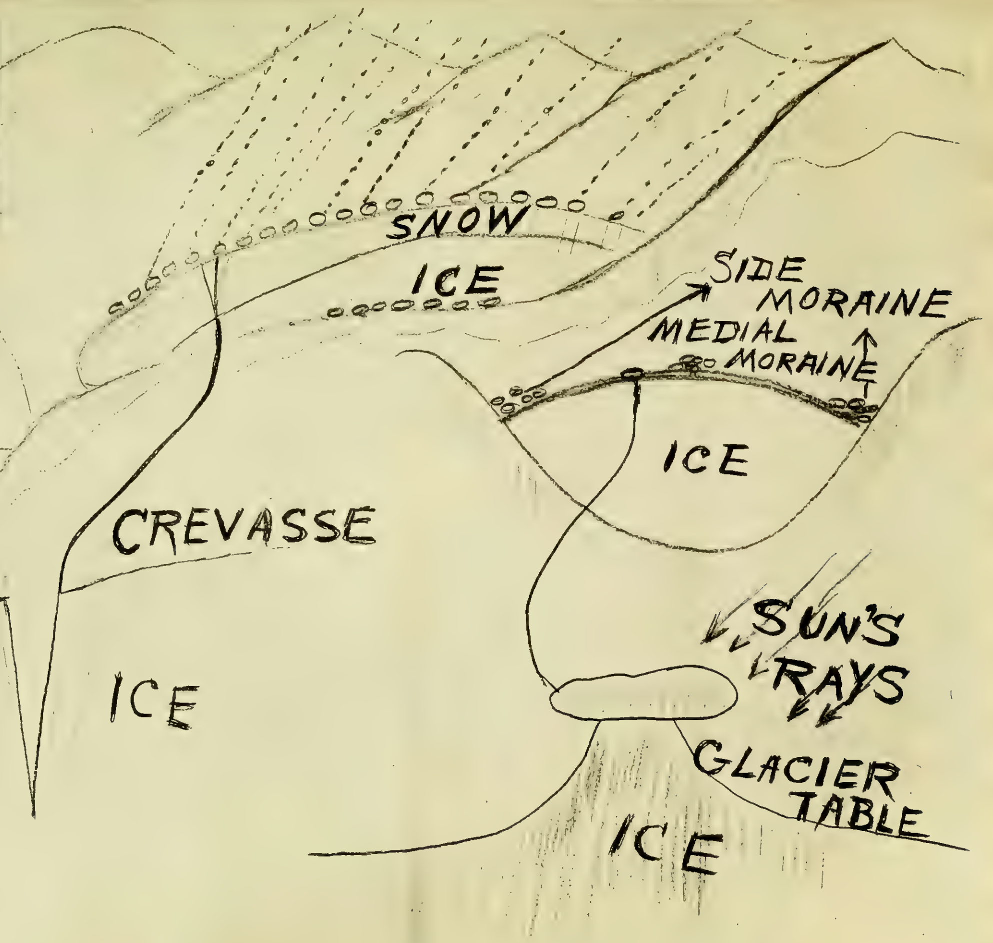


Chart 15. A cross section of a glacier.

The following day, December 14, Groups C and D of the seventh grade were given the same instruction outlined above, group C being the chalk-talk group, and group D being the film group.

During the presentations, assistants sitting to the left and in front of the groups estimated from minute to minute the number of pupils not paying attention to the instruction. This attention record was kept for each period of instruction. The assistants were trained for the work by the writer who copied the method from that used by H. C. Morrison of the University of Chicago Laboratory Schools.

(4) The tests. The test given each group immediately following the presentation was a three fold test made up by the writer's assistants, consisting first of a composition, second a question test, and third a chart or drawing test. The composition test was a spontaneous report by the pupils written on the story of a mountain glacier. The question and chart test were mimeographed on a single sheet. Each group received the following instructions before starting the tests:--

> "First write your name, grade, and homw teacher at the top of the blank sheet. Then write all you can remember of the story of a mountain glacier. As soon as you have finished your compositoon turn that sheet face down on your desk and then I will give you your question sheet.
>
> "Before starting to answer the questions write your name, grade, and home teacher at the top of your question sheet. Then fill in as many of the blank spaces as you can. You will be given time to finish. When you have finished fold your paper through the middle and bring it to me at the desk."

The papers were scored by the writer's assistants twice. The second scoring served as a check and was done by a second assistant six weeks later. The method of scoring the compositions is described above on page 164 .

The question test and accepted answer key are as follows:-

1. Where does snow accumulate? ____________________

2. Of what are glaciers composed? ____________________

3. What causes ice to form? ____________________

____

4. Where are glaciers usually formed? ____________________

5. __________ causes them to move.

6. How do glaciers move? __________

7. How are cracks and crevasses formed? ____________________

____

8. A moraine is composed of ____________________

9. The gravel pile on a glacier behind trees is called __________

10. Name the kinds of morraines. ____________________

11. How is a glacier table formed? ____________________

12. What happens when a glacier reaches the sea? __________

____

13. What is an iceberg? ____________________

14. What effect does the weather have upon a glacier? __________

____

15. A melting glacier forms a __________.

16. What is formed at the outlet of a stream? __________

17. How is it formed ____________________

____

____

18. Are deltas inhabited: __________

19. On back of this sheet illustrate (a) crevasse, (b) glacier table (c) delta.

20. Illustrate the two types of morraine on back of this sheet.

Scoring Key Used in Experiment Nine

Value of each question in points shown by number in brackets to left of question.

(1) 1. Up high in mountains, or high in the mountains, or on mountain tops.

(5) 2. Snow, ice, rocks, gravel, and dirt (one for each.)

(1) 3. Weight of snow, or packing down of snow, or weight and melting of snow.

(1) 4. In the mountain valleys.

(1) 5. Weight, or gravity.

(1) 6. Slowly, or very slowly, or an inch a day, or a foot a day.

(1) 7. By the glacier bending over a steep slope, or by going over a bump in a mountain.

(3) 8. Rocks, gravel, and dirt. (one for each.)

(1) 9. A moraine.

(4) 10. Medial, terminal, lateral, and sub-moraine or middle, end, or side (one for each).

(1) 11. By the sun's rays melting the ice from around a big rock on the glacier.

(1) 12. Large pieces break off into the sea.

(1) 13. A large piece of floating ice, or a piece of a glacier in the ocean.

(1) 14. It melts it back, or melts it.

(1) 15. Stream or river.

(1) 16. A delta.

(1) 17. By the dirt washed down by the stream.

(1) 18. Yes.

Total questions 27 points.

(3) 19. One point was given for each reproduced correctly.

(2) 20. One point was given for each moraine reproduced correctly.

Total chart	5 points
Grand total	32 points.

(Note. In experiment eleven an additional drawing was requested of the pupils. All the groups were asked to "draw a cross-section of a glacier." Each item correctly reproduced was scored one point. The "items" accepted were, the moraines, layer of ice, layer of snow, crevasse, mountain tops, valley, icebergs, and sea. This drawing represents a reproduction of chart 13 shown on page 254 .)

The memory tests were administered to the four groups five weeks after the original tests. Groups B and C of the eighth grade were given their test January 17, 1922, in the assembly hall. After the groups were assembled the writer gave them the following instructions:

> "How many remember the story of a mountain glacier which you heard me tell or saw in the film, before the holidays? (Show of hands.) To-day I am going to give you another test to see how much you remember about mountain glaciers. Put your name, grade and home teacher on the blank sheet, and write a composition about the story of a mountain glacier. When you have finished your composition, turn the paper over on the desk, and I will give you the question sheet. Then write your name on the question sheet. Answer as many of the questions as you can. When you are thru, fold your papers together thru the center, and bring them to me."

The seventh grade groups C and D were given their memory test the following day, January 18, to correspond to the same length of time between the eighth grade groups.

At the same time the memory tests were given January 17, eleven pupils from group A of the eighth grade were given the same test. This group had received no instruction on the Story of a Mountain Glacier, and were selected from group A at random.

The instructions given this group before taking the test follow:

> To-day I am going to give you a test on the Story of a Mountain Glacier. You have not received any instruction on this topic, but I want to know how much you know about glaciers already. Write your name, grade, and teacher on each sheet I give you. On the blank sheet write a composition on the story of a mountain glacier. When you have finished your composition, answer as many of the questions as you can on this question sheet which I will give you. When you have finished both tests fold your papers together thru the center and bring them to me.

These tests, written by the uninstructed group, as well as the memory tests were scored in the same manner described above on page 258. The second scoring was done several weeks after the first scoring. This served to check the original scoring, and to insure greater accuracy in scores themselves.

THE RESULTS. The scores made by each group in experiment nine were tabulated by groups and the averages were calculated and recorded in table 21.

Original Test. December 13 and 14. [illegible] School.

Group	Grade	No. of pupils	Ave. chronological age	Ave. intelligence score	Average I. Q.	Question Score			Chart Score			Comp. Score			Total Score		
						Average	% loss	M. D.	Average	% loss	M. D.	Average	% loss	M. D.	Average	% loss	M. D.
C chalk talk	7	27	13.03	[illegible]	107.14	12.41		[illegible]	[illegible]		1.08	[illegible]		6.06	40.00		6.30
D film	7	27	13.19	[illegible]	106.10	[illegible]		[illegible]	[illegible]		1.61	14.33		[illegible]	29.87		6.64
B chalk talk	8	[illegible]	13.90	[illegible]	108.70	15.71		3.00	[illegible]		.34	10.17		5.97	37.45		7.77
C film	8	[illegible]	[illegible]	[illegible]	[illegible]	11.60		[illegible]	1.70		1.25	13.90		[illegible]	27.40		7.90
					Memory Test. January 17 and 18. Five weeks												
C chalk talk	7	27	13.03	[illegible]	107.14	[illegible]	[illegible]	[illegible]	1.11	[illegible]	[illegible]	14.05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D film	7	27	13.15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42	1.02	13.77	4	3.76	26.56	11	7.00
B chalk talk	8	[illegible]	[illegible]	93.71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.01	[illegible]	[illegible]	[illegible]	27.14	[illegible]	[illegible]
C film	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	24.15	[illegible]	[illegible]

Table 21. The average scores made by the groups in experiment,—showing the original test scores, the memory test scores and the per cent of loss in the memory test.

These averages reveal that the chalk-talk groups made higher scores than the film groups in each item of the original three fold test in both grades. The differences between the two seventh grade groups in the question and chart test is very small, a difference of only .76 points or 5.9% on the question test, and .05 points or 1.1% on the chart test in favor of the chalk-talk group. The chalk-talk group, seventh grade, wrote longer compositions than the film group by 9.44 ideas per composition on the average. The difference between the two groups in the total score is 10.13 points making the total score of the chalk-talk group 34 per cent higher than the film group.

The eighth grade film group "C" made a noticeably lower score on the test than the chalk-talk group "D". In fact, the performance of the film group in the eighth grade is lower than either of the seventh grade groups in each item of the three fold test. The writer is at a loss to explain this performance, since the factors throughout the administration of the test were nearly constant in each group. Nothing happened during the conduct of experiment nine to account for the performance of group "C" which was observed by the writer or his assistants.

The scores made by group "C", eighth grade are lower than the chalk-talk group by 3.91 points or 33.1% in the question

test, by 1.87 points or 110.0% in the chart test, by 4.27 points or 30.7% in the composition test and by 10.05 in the total score. The total score of the chalk-talk group is 37 per cent higher than the film group's total score. This is almost the same relationship between the total scores as was found in the seventh grade.

An examination of the scores made in the memory test shows that the residual score for the seventh grade film group "D" is higher in each item than the chalk-talk group "C" with the exception of the composition test score.

The differences between the two groups, however, are very slight being less than one point in each item. The percent of loss is therefore greater for the chalk-talk group than the film group in each part of the test, the most noticeable difference in loss showing in the composition test where the film group only recorded a loss of 4 percent as compared to the chalk-talk group's loss of 41 percent.

The residual score recorded by the eighth grade groups shows the chalk-talk group to have the higher score in each item with a total score 12 percent higher than the film group in the question score, chart score, composition score and total score. In experiment nine the film group's percent of loss is lower than the chalk-talk group in every item of the three fold test in both grades. This

result adds more weight to similar findings in experiment six, seven, and eight.

The uninstructed group which took the three fold glacier test performed as shown in Table 22.

Group	Grade	No. pupils	Ave. chronological age	Ave. score intelligence test	Ave. intelligence quotient	Ave. question score	Ave. chart score	Ave. composition score	Ave. Total Score
A uninstructed	8	11	12.85	93.65	106.4	4.09	.27	8.50	12.86

Table 22. The scores made by the uninstructed group in the 8th grade in the glacier test.

On comparing the scores made by the uninstructed group with the average of the average scores in each item of the test made by the eighth grade groups, we find that the uninstructed group made a score of 29 percent as high as the average in the question test, 10 percent as high as the average in the chart test, 55 percent as high in the composition test and a total score 39 percent as high as the average total score.

This indicated that the eighth grade pupils had gained some knowledge previous to the experiment concerning mountain glaciers from their geography class room work. On inquiry this was found to be the case. From the viewpoint of previous knowledge the chart score was least affected by that factor.

Another factor should be considered in this con-

question, namely the make up of the test itself. A critical examination of the test questions shows that the answer to a number of the questions can be found in the question following that particular question. The assistants who made up the test failed to remedy that situation. The writer was unable to correct this error before the experiment since he was to give the oral instruction, and hence was not permitted to see the tests until after the close of experiments nine and ten.

The attention analysis was made in terms of the number of pupils not paying attention to the presentation per minute. The assistant making the analysis was instructed to watch the group and record the number of pupils who were observed not paying attention. The assistant sat in front of and to one side of the group.

The method of recording the analysis was as follows: first, a line was drawn and below the line the number of pupils in the section was placed as a denominator; then the line was divided into phases of a minute each. The lapse of time from the beginning of the period was indicated by the upper row of figures worked with the minute sign. The numerators immediately above the line indicate the number of pupils in attention from time to time. The fraction at the right is the computed total average time in which the class was in a learning situation.

ATTENTION ANALYSIS

EXPERIMENT NINE

1'	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"		
17	23	24	24	25	25	22	24	23	24	24	22	25	300	= 82.41%
28	28	28	28	28	28	28	28	28	28	28	28	28	364	

Group C, Chalk-talk. Seventh grade. December 14.

Observer Miss Neville.

1'	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"		
31	29	27	31	29	28	22	31	27	28	28	31	25	362	= 84.38%
33	33	33	33	33	33	33	33	33	33	33	33	33	429	

Group D, Film. Seventh grade. December 14.

Observer Miss Stuart.

1'	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"		
38	39	38	39	40	38	38	30	35	34	38	40	36	483	= 90.81%
41	41	41	41	41	41	41	41	41	41	41	41	41	533	

Group B, Chalk-talk. Eighth grade. December 14.

Observer Miss Hilgard

1'	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	*12"	13"		
39	33	36	35	39	34	40	38	40	34	30	20	36	454	= 87.30%
40	40	40	40	40	40	40	40	40	40	40	40	40	520	

Group C, Film. Eighth grade. December 13.

Observer Miss Neville

---

* Atwood's continued drawing bored the children at this point.

The accuracy of this method of attention analysis is of course open to criticism. Even though a pupil may appear to be in-attentive, he may be paying strict attention, and vice versa. However, a child might be paying attention without looking at the lecturer in the oral group, but not without looking at the screen in the film group. At any rate, this method serves as a check on the attention situation, which is more accurate than the opinion of the observer of the class period as a whole.

The per cent of time during which each group was at attention during the presentation reveals that the seventh grade groups were not as attentive to the presentation as they should have been. The attention in the film group was slightly better than in the chalk-talk group. In the eighth grade the chalk-talk group seemed to pay more attention to the presentation than the film group.

One noticeable fact was reported by the observers of the film groups, namely, that toward the end of the caption of scene in the film the pupils became inattentive and restless waiting for the next scene or caption to appear.

The contention held by film enthusiasts that one always secures one hundred per cent attention to the showing of a film is not upheld by the analysis reported above.

Experiment 10.

PROBLEM. One of the major types of visual aids is the stereograph. Experiments one to nine have only dealt with the film, the slide, the wall map, the blackboard sketch and the chart. It was decided to organize experiment ten to compare three different methods of instruction; first, a stereopticon lecture; second, a discussion supplemented by stereographs; and, third, a film presentation.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects.

The pupils selected to act as subjects were the members of groups A and B eighth grade and A and B seventh grade [illegible] school. These groups were then broken up into four groups by the method described on page 123 on. The sub-division was essential in order to organize the presentation of the [illegible] unit in terms of the [illegible] [illegible].

(2) Topic. "The Story of a Mountain Glacier" was selected to be the subject of the unit of insturction. The film used in experiment nine was used in experiment ten for the film instruction.

Charts copied from the film and one black board sketch prepared by the writer before each period of instruction served to duplicate Mr. Atwood's drawing in the film for the stereograph and slide instruction. The illustrations in the film were duplicated by stereographs numbered 276, 219, 274, 275, 428 and 427 and slides numbered 276, 219, 274, 275, 428 and 427 from the Keystone View Company's "600" set.

(3) Presentation of the topic. On December 14, 1921 group "D" eighth grade was divided into four sub-groups a, b, c and d by the method described on page .

Sub-group "a" of group "D" consisting of ten pupils was assembled in the history classroom where the writer had arranged each of the stereographs to be used in the experiment in a pile on each desk in order of sequence. Each pupil was supplied with a stereoscope. This ten-pupil-group arrangement was made necessary thru the fact that there were only

ten stereoscopes available for each group. It was essential that each pupil have one set of the stereographs and one stereoscope so that the time of presentation could be kept constant and no time wasted in passing stereoscopes and stereographs from pupil to pupil.

The writer had at the start of the period two charts copied from the film hanging from the blackboard and one sketch from the film drawn on the blackboard to duplicate the work of Atwood shown by the film.

As soon as the pupils were settled in their places the writer gave them the following instructions;

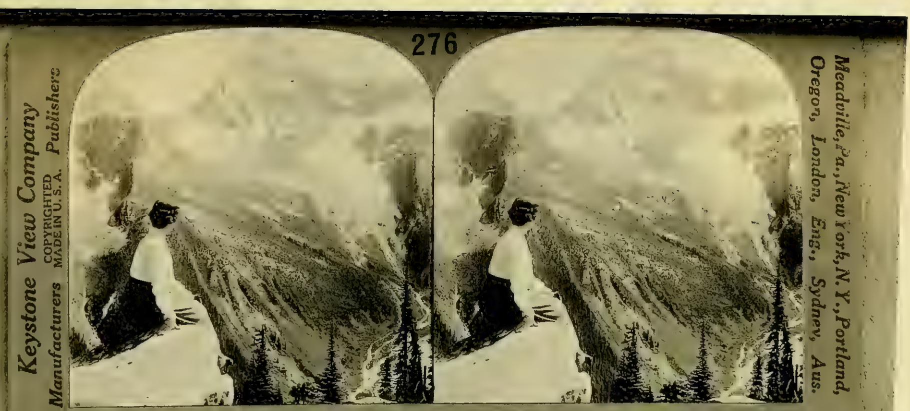
> "Today I am going to tell you the Story of a Mountain Glacier. On your desk is a stereoscope and stereographs. You all know how to use them do you not? (Show of hands.) When I start talking pick up your stereoscope in your left hand and hold it in readiness to use. Turn over your pile of stereographs and when I tell you to look at your first picture put the stereograph in the holders and look at the picture. From time to time during the talk you will want to look at the blackboard and the charts I have here, I will tell you when to look at the blackboard and when to look at your next picture.

> Pay strict attention to all you see or hear for I am going to give you a test to find out how much you have learned about Mountain Glaciers. Do you all understand what to do? (Show of hands. One boy needed further explanation.)

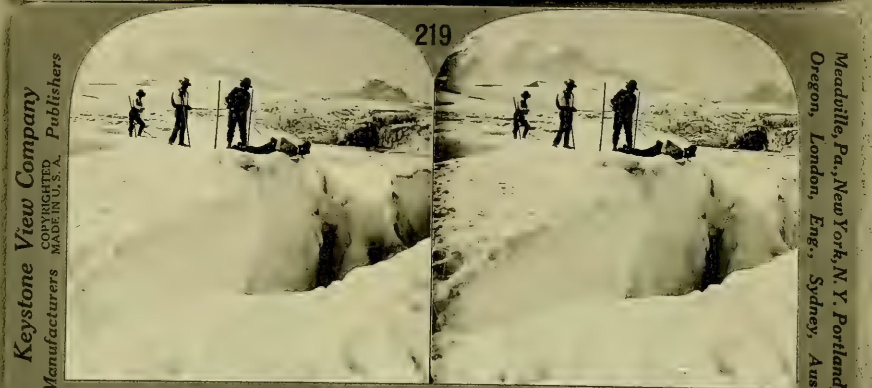
The presentation of the topic lasted for 13 minutes. A stenographer was present and recorded verbatim the oral instruction. The stenographic report of the oral instruction follows:-

The stereographs used in this experiment are inserted at this point and should be compared with the cuts of the film shown above. The slides were exact copies of these stereographs.

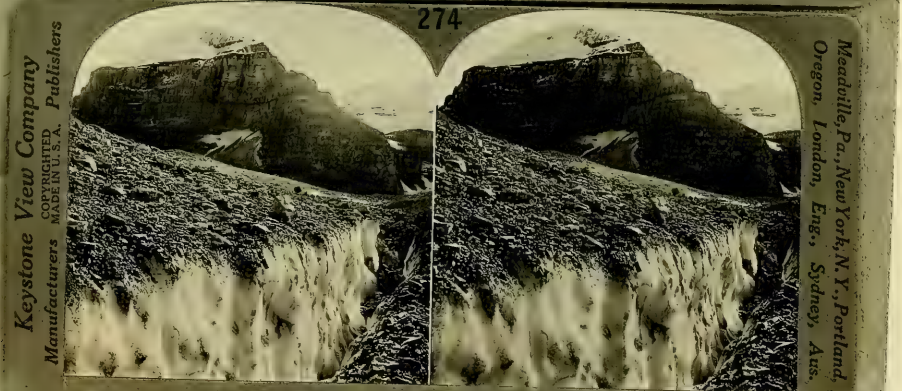
The stereographs were shown in the following order;- numbers 276, 219, 274, 275, 428 and 427.


276
Keystone View Company
Manufacturers COPYRIGHTED MADE IN U.S.A. Publishers
Meadville, Pa., New York, N.Y., Portland, Oregon, London, Eng., Sydney, Aus.

18806—Mt. Sir Donald, the Matterhorn of the North American Alps, British Columbia, Canada.


219
Keystone View Company
Manufacturers COPYRIGHTED MADE IN U.S.A. Publishers
Meadville, Pa., New York, N.Y. Portland, Oregon, London, Eng., Sydney, Aus.

14135—Looking Down a Deep Crevasse of Paradise Glacier, Summit of Mt. Rainier in the Distance—Rainier National Park, Washington.


274
Keystone View Company
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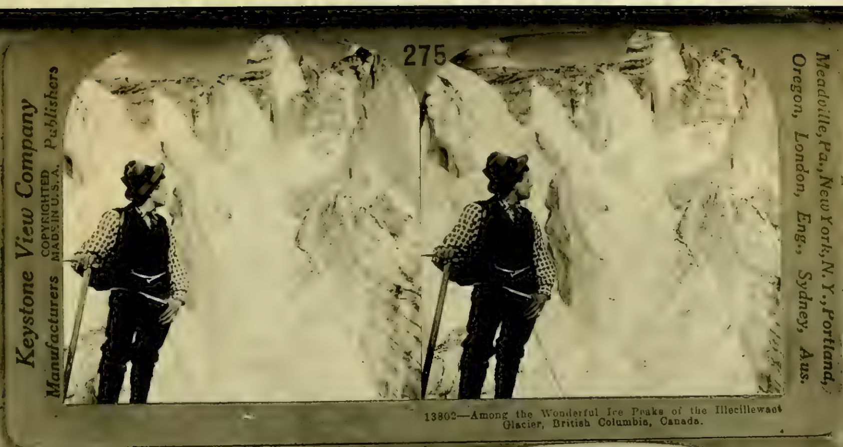
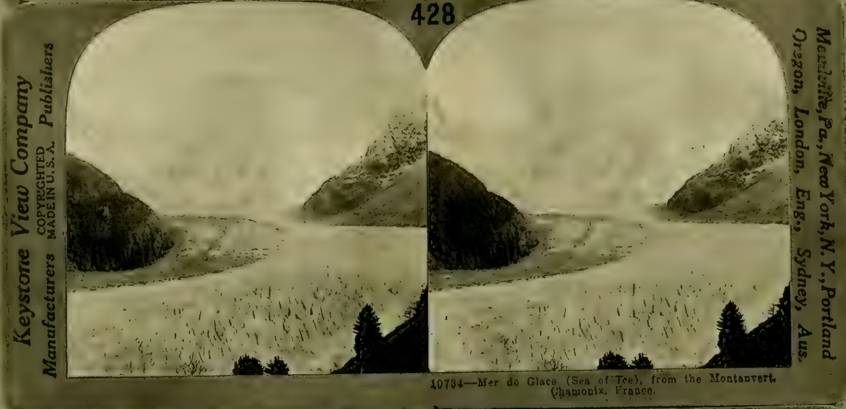
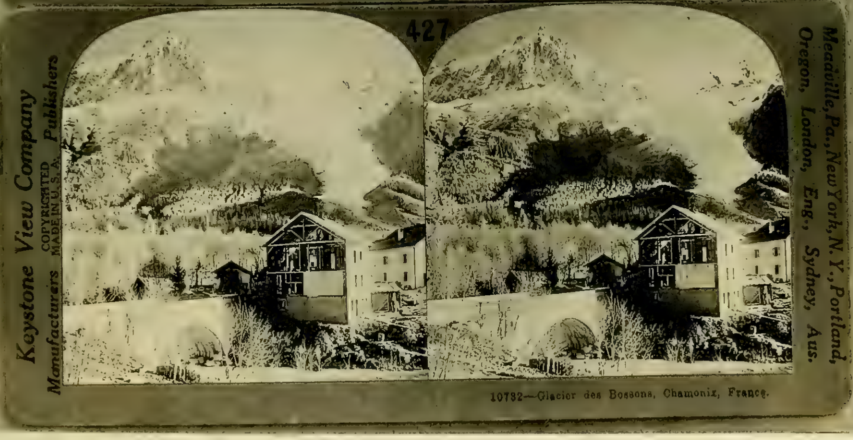
13830—A Treacherous Crevasse in Victoria Glacier—Mt. Lefroy and Mt. Victoria in Distance, Canadian Rockies, Canada.


275
Keystone View Company
Manufacturers COPYRIGHTED MADE IN U.S.A. Publishers
Meadville, Pa., New York, N.Y., Portland, Oregon, London, Eng., Sydney, Aus.

13802—Among the Wonderful Ice Peaks of the Illecillewaet Glacier, British Columbia, Canada.


428
Keystone View Company
Manufacturers COPYRIGHTED MADE IN U.S.A. Publishers
Meadville, Pa., New York, N.Y., Portland Oregon, London, Eng., Sydney, Aus.

10734—Mer de Glace (Sea of Ice), from the Montanvert, Chamonix, France.


427
Keystone View Company
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Meadville, Pa., New York, N.Y., Portland, Oregon, London, Eng., Sydney, Aus.

10732—Glacier des Bossons, Chamonix, France.

Oral Instruction Given to Stereograph Group.

I am going to tell you this morning about the story of a mountain glacier, that is, how it is formed, and what it does.

In the first place, a mountain glacier is formed by the accumulation of snow high up among the mountain tops, which falls and rolls down into the valley and fills it up. You see in your stereoscope, a picture of a high mountain, and you notice that on each side of the mountain there is a glacier which comes down to form a big glacier at the bottom of the mountain. The snow may be two or three hundred feet in places, and when the snow falls it forms a big heavy mass; just as you make a snow ball by packing it together, which forms ice, this heavy mass of snow weighs down the snow underneath and forms ice underneath.

Here you will see a cross section of a big mountain; here is the high mountain and the snow is coming down, represented by the top layer, and **fills** up the valley, and here it becomes so heavy that it packs down the snow underneath and forms a great coat of ice. Now the glacier moves down the valley just by force of gravity. It comes down hill; it simply has to move down hill. As it moves down hill, it carries down with it a tremendous amount of rocks, gravel, sand, etc. You see along the edges of the snow a lot of dark material which looks like dirt. That is the accumulation carried down. It is called a moraine. Now if you look here again, you will see the different kinds of moraines. A cross section of the glacier in this fashion- we have here along the side of the mountain the glacier as carrying down with it a certain amount of dirt and gravel. That is the lateral moraine. Then when two glaciers in little valleys come together, as they do here in this glacier, the lateral moraines continue to go ahead and that forms a series of rocks and dirt, etc., along the middle of the glacier. There you have two of these series. That is called a medial moraine. Then as the glacier comes down the hill, it drags some rocks underneath, and that is called a sub-moraine. Now the glacier comes down into the valley and begins to melt away into the ocean, and this rock that comes with it, and that mass at the end of the glacier is called the end moraine. Here you have four kinds of moraines; one on the side, one in the middle, one underneath, and then the accumulation that comes into the valley.

Another peculiar thing about glaciers is that we want to consider is the fact that when they go over a bump on the mountain they crack. Look at your next picture. You see a big mountain has caused a big crack in the ice; that is a crevasse, and this is how the crevasse is formed. It goes over a bump and cracks and this is all lined with ice on each side, and if a man falls into one of these crevasses he is likely to be killed. One of these crevasses may be two or three hundred feet

deep.

Now look at your next picture; you will see another picture of a crevasse, or big crack in the ice, and also the top of the lateral moraine on the side of the glacier. All that material is carried along with the glacier down the mountain side, and here again is another big crevasse.

Now another peculiar thing about the glacier is the fact that we have a formation of so-called glacial tables. There you see a number of big cracks in the ice. The glacier table is formed in this fashion. Here is your glacier across the top, and then there is a big rock on a glacier and a part of a moraine. The sun's rays come down on the glacier and melt away the ice underneath the rock, and this ice is left in this fashion underneath the rock, and this ice all melts away, and we have nothing but ice here left.

After the glacier has moved down the mountain side, if it is near the ocean, it runs down into the valley and reaches the ocean and breaks off and forms big ice bergs. It keeps rolling down the mountain side, and here we have the ocean level, and this is the depth of the ocean-and breaks off ice into great chunks of ice, which flow away, and are called icebergs. If a ship comes in contact with it, it sinks. Here is another picture of a glacier reaching the valley, and having icebergs break off and flow away in the ocean. On the other hand, some glaciers are not near the ocean, and they come down into the valley in somewhat this fashion, and here we have the formation of land, all along through the valley, and the glacier begins to melt back. It is too warm before it reaches the ocean, and a river forms which goes in this fashion and carries this submoraine and terminal moraine out into the ocean and forms a delta. Along the side of the bank people in this delta valley build houses and live there and enjoy life; in fact, the state of Illinois is a moraine which has been left, and the Mississippi River is carrying this material down and formed a delta in the Gulf of Mexico. On the next slide you will see a picture of a glacier which has melted back. If you look at the next slide you will see a picture of a glacier which has actually gotten to the valley and formed a stream, which will become a river, and later forms material for a delta, and people live in the valley thus filled up by the stream, caused by the melting of ice. It is when the climate becomes too warm.

As soon as the presentation was finished the group was placed under the care of an assistant, passed to the assembly hall and given the test.

Sub-group "b" of group D followed sub-group "a" to the history class room and received its instruction which was an exact repetition of that given to sub-group "b" described above.

On December 15, 1922, group A eighth grade was divided into four sub-groups a, b, c, and d by the method described on page 123. Sub-groups a and b of group A were assembled in the geography class room and given the following instructions:-

> "Today I am going to tell you the story of a Mountain Glacier. My discussion will be supplemented by drawings, charts and lantern slides. Pay strict attention all you hear and see for I am going to give you a test at the end of the period to find out how much you know about mountain glaciers."

The stereoptican lecture and discussion lasted 13 minutes. A stenographer was present and recorded verbatim the oral presentation. The stenographer's report of the oral instruction follows:-

Oral Instruction Given to Stereopticon Group

Today I am going to tell you a story about a mountain glacier. In the first place, a mountain glacier is the result of the accumulation of snow high up among the mountain peaks, and you see here in this chart the high mountain peaks where the snow has fallen down, year after year, because they have continual snow there, and fill up the valley two and three hundred feet deep. Now the weight of the snow in the valley causes ice to form underneath the glacier. This snow also melts and runs down just like you make an ice snow ball, and we have this ice forming underneath the glacier and down in the valleys. After the glacier comes a tremendous amount of snow and ice, and it begins to move slowly down the valley by force of gravity, because it wants to go down hill, and it slides along down the valley. If you look at this slide a minute, I will show you a picture of the glacier. See, the snow has accumulated high up among the mountain peaks and the valley is filled with snow, and underneath there is ice, and the glacier to the left and right join in the big valley to form another glacier, which goes down and begins to melt where it becomes warm.

A peculiar thing about the glacier is the fact that as it moves down the valley it accumulates a lot of dirt, rocks and gravel along the line, especially in there, and in here (the dark lines). That is the accumulation of gravel and dirt as the glacier moves down the mountain side. In this chart you see also represented these rocks here on top of the glacier, which is in cross section, and some of these rocks come from the side of the mountain, some roll down from the mountain on the glacier. Here we have another cross section. Underneath (here) is the bottom of the valley, and the mountain sides, and here is ice, and on each side of the glacier we have a moraine. The moraine is this accumulation of rocks and dirt and gravel, that we have spoken of, and we have side moraines and then medial moraines. The side moraine is sometimes called a lateral moraine. Now the side moraine is the result of the accumulation of rocks along the side of the glacier next to the mountain wall. Then when two glaciers, one in each valley, come together, and begin to move on down into the valley below, this accumulation of rocks along this side and this side (pointing) continue to move with the glacier, and you find in the middle of the glacier a pile of rocks and gravel and stone, etc., and that is called a medial moraine, as I have

pointed out before. In this picture you have two medial moraines, one at this point, and one at this point (pointing). Then as the glacier moves along down the mountain side, it also carries a certain amount of rocks and gravel with it underneath the glacier, and the material underneath is called a sub-moraine. The sub-moraine underneath and the lateral moraine along the side, and the medial moraine, all keep going down the valley with the glacier; when the glacier reaches the ocean, and that melts, this accumulation of dirt and stone and rock and gravel is left there in great piles, and we call that the terminal or end moraine. Here we have four kinds of moraines: the medial, the side or lateral, the sub or terminal. If a glacier is going around a tree the tree will sometimes cause a great deal of rock to stop behind it, and we call that a moraine. As the glacier moves down and when it hits a bump, the ice cracks and we get a great crevice, or splitting of the ice, and here is the glacier moving down the mountain very slowly indeed, and it hits this bump, and as it goes over the bump it makes a crack. Some times it is two or three hundred feet deep. It is dangerous to climb in the mountains, and these men here are looking down into this crevice maybe hundreds of feet deep. Sometimes a mountain climber falls into this crevice and is killed, and the bodies are not found until the glaciers have come into the valley, where the body is found in the ice.

Now in the next slide we see another crevice picture, and with it a lateral moraine. We see there this great accumulation of rocks and gravel on the top of the glacier, and also a great crevice in the ice where the glacier has bent over a slope in the mountains. Another curious thing about glaciers is the fact that certain stones which are very large resting on the ice form glacier tables. Glacier tables are explained in the following manner. Look at the little chart down here. Here is the surface of the glacier and the stone resting on it; the sun's rays beat down there above, and melt the ice away from the rock, all except the ice right under the rock, and as a consequence we have a table, made of ice, with a stone resting on top of it. That is what you see here. These are glacier tables. Many times the stones slip off. There are also some crevices which help to make this look like you were among mountain tops. That is how the glacier table is formed. Now, as the glacier moves down into the valley, and as the valley leads down to the sea or ocean, the glacier will break off and form ice bergs. In the chart which is uppermost to the left of the picture, the glacier has reached the ocean and has begun to break off, and these

ice bergs are floating away, and hundreds of thousands of these break off and drop into the sea. We can represent it here in this chart. The glacier moves down the mountain very slowly until it hits the sea level, and then these great hunks of ice break off into the sea and we have ice bergs. Of course, if ships run into the ice bergs, they generally meet with disaster, and of course they are very dangerous on that account. On the other hand, if the glacier comes down the valley, as it does in many cases, and does not reach the sea, because it is too warm, or the sea is too far away, it begins to melt. Thus, the glacier begins to melt and in melting, of course, a great amount of water runs away into a creek, and later the accumulation of this water forms a river, and the river carries the dirt and rocks and stone down into the valley and fills up the valley, rolls out to the ocean, and forms a delta. There is a picture of one of these glaciers far away from the ocean, but which is melting and has reached this point in the valley, and a stream is formed; then it runs down carrying with it this material of rocks and gravel that have accumulated at the end of the glacier's trip. If we could imagine here the glacier melting back up to this point, we would have a river coming down here and forming a delta, building up land in this fashion; and then people build their houses and live along the side of this naturally formed delta or valley. I have another picture showing how the glacier melts back to form a stream. The stream is at the right, running from the glacier, and this, in turn, carries this material on into the valley, and eventually it reaches the ocean and fills out a big delta.

At the end of the presentation period the group was placed under the care of an assistant and passed to the assembly hall, where it was given the test.

Sub-groups "c" and "d" of group D, eighth grade, followed sub-groups "a" and "b" of group A to the geography class-room. The following instructions were given this class: --

> "Today I am going to show you a film which tells the story of a mountain glacier. Pay strict attention to all you see, for you will be given a test at the end of the period to find out what you know about mountain glaciers."

The film instruction lasted fifteen minutes. This was two minutes longer than the time of instruction given the other groups. The projector used was a De Vry portable which required a rheostat adjustment to equal the speed of the American projector. This adjustment was not properly made, with the result that the projection time was fifteen minutes instead of thirteen minutes. (See page for an outline of the film.)

On December 16th groups A and B of the seventh grade were divided into sub-groups, four to each group, and were given instruction exactly as described above for the eighth grade groups. Sub-groups "a" and "b" of group A, seventh grade, received "stereograph" instruction and sub-groups "a" and "b" of group B, seventh grade, received "film" instruction.

(4) The Tests. Immediately following each presentation period the three fold test described in experiment nine was administered to each group by the writer's assistants.

Six weeks later, on January 18, 19, and 21, memory tests were given the respective groups to correspond to the dates of the first presentation. The methods of giving the memory test and the instructions to each group were the same as those given to the groups in experiment nine.

The papers were scored and checked by assistants at the same time the papers collected from experiment nine were scored and checked. (For a full description of the tests and scoring see pages 251-259 experiment nine.)

THE RESULTS. Pupils who were absent from the memory test and the corresponding pupils in the other groups were thrown out of the final tabulation of scores in order to equalize the groups in number, age, intelligence test score and intelligence quotient. Furthermore the sub-groups were recombined into large groups by placing all the groups which had "film", "stereograph" and "slide" instruction under their respective heading regardless of grade. This was done in order to equalize the chance factors by the weight of numbers. Hence, three groups of 37 pupils each were formed which will be designated as the "stereograph," Slide", and "film" groups respectively.

The average scores made by each group in the three fold test were tabulated and are shown in table 26.

Original test.

	Grade	No. pupils	average chronological age	average Intelligence test score	average Intelligence quotient	average question score	% loss	M I	average chart score	% loss	M I	average composition	% loss	M I	average total score	% loss	M I
Stereograph	7& 8	37	12.89	86.52	105.14	14.18		3.01	2.78		1.15	26.46		5.43	43.42		6.30
Slide	7 & 8	37	12.75	86.15	106.00	14.68		2.58	2.89		1.04	23.21		4.89	40.78		6.17
Film	7 & 8	37	12.91	86.43	105.89	12.08		2.91	1.65		1.27	16.48		4.98	30.21		5.50
Memory test. (Six weeks)							% loss			% loss			% loss			% loss	
Stereograph	7 & 8	37	12.89	86.52	105.14	11.97	15	2.15	1.89	34	.95	14.10	46	5.11	27.96	35	7.01
Slide	7 & 8	37	12.75	86.15	106.00	12.35	15	2.08	1.81	37	1.01	14.08	39	5.08	28.24	30	6.89
Film	7 & 8	37	12.91	86.43	105.89	11.22	7	2.17	1.51	8	1.10	11.35	31	4.91	24.08	20	6.08

Table 23. The average scores made by each group in experiment ten showing the original and memory test scores and the per cent of loss shown by the memory test for each group.

An examination of Table 25 shows that the film groups made the lowest score in each item of the three fold test. This same result was found in experiment nine. The slide group made a slightly higher score than the stereograph group on the question test and chart test a difference of .50 points or 3.4 percent and .11 or 3.9 percent respectively. However the stereograph group made a score higher than the slide group in the composition test and total score by 3.25 points or 14.0 percent in the former and 2.64 points or 6.4 percent in the latter. The total score of both the slide and stereograph groups was over 10 points higher than the film groups total score which when stated in terms of percent shows the slide group to be 35 percent higher than the film group and the stereograph group to be 45 percent higher than the film group on the total score. (Experiment nine showed the chalk-talk groups to be 55 and 37 percent higher than the film groups by the total score in grades 7 and 8 respectively.)

The memory test reveals a percent of loss for the film group lower than either the stereograph or slide group in each part of the test. This result is the same as that found in experiment nine. However, in the residual score the film group is lower than either the slide or stereograph groups. The residual scores made by the slide and stereograph groups are too close together to show any advantage for either group, the total score being .28 higher in the slide group. However, there is

one significant difference between the stereograph and slide groups and that is the fact that the stereograph group wrote a larger number of acceptable ideas into its compositions than the slide groups by 14 percent in the original test and 13 percent in the memory test. Likewise the stereograph group surpassed the film group in the composition test by 60 percent in the original test and by 24 percent in the memory test.

Experiment Eleven

PROBLEM. A third experiment using the film "The Story of a Mountain Glacier" was organized to check the results of experiment nine. This third experiment was a comparison between the amount of information gained from hearing a teacher tell the story of a mountain glacier, illustrated by sketches, with the amount of information gained from seeing one showing of the film.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. The Leal School groups A, B, C, and D of the fifth and sixth grades were selected to act as subjects in experiment eleven.

(2) Topic. The film depicting the story of a mountain glacier served as a basis for the instruction presented in experiment eleven. The teacher, using two charts and one blackboard sketch copied from the film, attempted to duplicate the film's material as closely as possible.

(3) Presentation of topic. On January 6, 19[illegible] groups A and C of the fifth and sixth grades respectively were assembled in the sixth grade room described on page 127. They received the fol-

lowing instructions from the writer: --

> "Today I am going to show you a film which will tell you the story of a mountain glacier. How many know what a glacier is? (Show of hands indicating that very few knew what a glacier was.) Pay strict attention to all you see, for you will be given a test at the end of the period to find out how much you have learned about mountain glaciers."

The film was shown the two groups. The time involved was thirteen minutes. (See page 250 for an outline of the film.)

Simultaneously with the film instruction period, groups B and D of the fifth and sixth grades, respectively, were receiving their oral instruction from Miss Wiley in the fifth grade room. The preliminary instructions which were given to these groups follows: --

> "Today you are going to hear the 'Story of a Mountain Glacier'. How many know what a glacier is? (Show of hands.) Pay strict attention to allyou see and hear, for you will be given a test at the end of the period to find out how much you have learned about mountain glaciers."

The teacher then began her discussion and continued for thirteen minutes. A stenographer was present who took the following verbatim account of the teacher's oral instruction: --

Leal School Lecture on Glaciers

given by Miss Wiley, January 6, 1922

I am going to talk this afternoon about a glacier. I know you people would like to know how much you can find out about glaciers, and Mr. McClusky is giving this test so that you and some other people can find out about this.

Just think about a place in the Northern part of the United States, probably down in the Michigan, up in Greenland, or the Northern part of the United States or in Canada, where there are high mountains, like those that you see here, like the tops that you see here, or on the blackboard. In most of those places it is so cold that all the year around you have snow. This snow gets deeper and deeper and deeper, and the deeper it gets, the harder it presses down, until finally at the bottom all that you have is something that is just like you have in your hands when you make a snow ball, and you know the harder you press it, the more water drops, and the more like ice it gets. Now when this snow piles up like it does, until it is three or four or five hundred feet deep, then you know at the bottom it has changed from snow until it is ice.

Now after awhile, it is going to keep pressing so hard that that which is underneath is going to push out. It is just like you press something real soft, so that at the bottom something is going to push out. At the top of one of these mountains this snow will begin at the bottom to push out and down. Now how fast is it going to come down the mountain side? That depends upon how steep your snow is. The harder you press, the faster you go. It depends upon what kind of day it is. If it is going to be warm, the snow will melt fast, and the snow will come down the mountain faster. In the winter time, it will move very, very slowly. On some mountains it moves one or two inches a day. On other mountains it moves two to four feet a day, and on some mountains it has been known to move fifty or sixty feet a day down the mountain.

Now let us look here; here is the mountain and here is a mountain. In between these two sides, and in between these is a valley, and the snow from these two glaciers finally comes into the valley and will become one. Now when all that comes together, there will be places that will move faster than others. In the center, it is going to move faster than on the sides. On the mountain sides

are little parts of land on which may be trees that will hold it back, while in the middle it will push out like this. That which is on top will move a little faster than that underneath, after it has started down the valley. Now, because the mountains are not the same height there is something going to happen to the ice on the bottom side. We are going to think that we are coming to a place where some of the land juts out of the mountain into the valley, and it will go faster and make a break. Now all these places that break in the ice look similar to this.

These pictures show a cross section. If I cut an apple in two, you can see a layer of peeling and a layer of meat, and the seeds; that is a cross section. If you cut across a tree like this, you see the bark and rings; you see a cross section. You just cut down the middle of this, and you have a cross section. This has come down this side like this, and off this place you make this crack or crevice.

Now as the ice moves along, it is going through some places where there was no ice, and will pick up something, maybe some rocks, dirt that is very fine, and maybe some pieces of gravel; all sorts of things. In places where the ice block is so deep, it may even drag a tree down, and it will bring that along right at the bottom of that ice.

Now I want you to think of the walk around the school house in the spring, after the snow has been off the ground for a couple of weeks, and it has melted, and when that finally does go away. You know how dirty the walk looks. There are great layers of dirt that have been left there. This glacier comes down for a way and it does not move, and right there where it stops moving and begins to melt back, it will leave this rock and dirt and everything, and that dirt and material which is left there is called a moraine. Some of this dirt is carried underneath the ice, and that dirt is called a sub-moraine. The word "sub" means "under". Now we have two glaciers, one coming down this mountain, and one down here, and each one of those is going to be carrying some dirt and some of this dirt will be out on the side. There is another word that means side, and that is lateral, and that is called a lateral moraine. Thus we have the lateral moraine or side moraine. Now two of these come together in here, and there are some lateral moraines here and lateral moraines here, and when the two glaciers come together those two lateral moraines here come together in the center or middle, and we have the medial moraine. There are side moraines, here is a side moraine, and these two make a medial moraine.

Now when the glacier comes to a place it stops moving and melts back and the dirt is left there, and that moraine is at the end of the glacier, that is called a terminal moraine. Sometimes we have a jut of this ice and rocks and dirt that is tipped up, and we wonder what happens to the ice underneath the rock. The rock does not let the light through. If it happens to be a big rock, this ice will not melt underneath, and the ice around the glacier that does not melt is called a glacier table. This moves down and all this here is ocean. And the glacier comes down this valley until finally we have it here at the water's edge, and then when it comes to the edge pieces break off and they go into the water, and these are ice-bergs. After getting into the water, these are very, very dangerous. Some ice-bergs are some five or six hundred feet tall, just as the glacier was when it came down the mountain. Now about one-eighth of that ice-berg is going to stay above water, and the rest will stay under water, so you see it is dangerous to ships.

When the glaciers melt where it is warm, in the warmer regions, they are going to leave a valley. When a river works down into the rocks it is sharp .... The glaciers when they melt back leave a valley like that. This has gradually melted back, and that leaves a valley. This represents a valley. Now, what is in the valley? Underneath that glacier was a sub-moraine, which was dirt, rocks, and vegetables carried underneath the ice, and when that ice melts back, your valley is the dirt, rocks and gravel, forming land, and these places in a river where they carry dirt are called deltas. When a glacier moves back, the remaining dirt, rocks and gravel left is called a delta, and then people come out to build homes and farms, and cities and places to live, on those deltas. In lots of places glaciers dig lakes instead of making land. In our New England States we have glacier lakes; places where the ice was cut out by glaciers, and these are called glacier lakes. In Greenland and in the Atlantic regions we have glaciers.

The stenographer reported that the teacher, Miss Wiley, talked very fast, which is evident when one compares the length of her discussion with that given by the writer in experiments nine and ten.

During each instruction period assistants recorded the attention of the pupils to the presentation in terms of the number of pupils who were not paying attention from minute to minute. (See page 267 for description of this method.)

(4) The Tests. The pupils returned to their desks after the instruction periods were brought to a close and were given the three fold test described in experiment nine with the exception that they were asked to draw a cross-section of a glacier in addition to the drawings called for in questions 19 and 20.

The memory test was administered on February 17, 1922, six weeks after the original test. (Note: For a full account of the test, the preliminary instructions, and the method of scoring the papers, see experiment nine, pages 257-259 .)

RESULTS. The averages made by the groups in experiment 11 are shown in table 24.

Original Test. Jan. 6, 1922. Leal School

Group	Grade	No. of pupils	Ave. chronological age	Ave. intelligence score	Average I.Q.	Question score			Chart score			Composition score			Total score		
						Average	% Loss	M.D.	Average	% Loss	M.D.	Average	% Loss	M.D.	Average	% Loss	M.D.
B oral	5	26	10.44	62.81	103.15	8.15		3.10	1.60		.76	13.04		1.86	22.79		4.61
A film	6	26	10.62	53.10	103.84	6.19		3.04	1.31		1.24	13.69		3.59	21.19		6.25
C film	6	26	11.40	66.96	106.30	8.50		2.08	1.90		.72	11.65		2.75	22.55		4.69
D oral	6	26	11.89	66.66	101.40	11.88		2.89	2.00		.85	16.60		3.72	30.90		5.12
Memory Test. Feb. 17, 1922.																	
B oral	5	26	10.44	62.81	103.15	8.04	1.4	2.40	.96	40	.58	10.00	23.4	2.19	19.00	16.2	4.76
A film	5	26	10.62	53.10	103.84	6.74	*8.8	2.52	1.30	.8	1.16	10.46	23.6	2.51	18.50	12.7	5.55
C film	6	26	11.40	66.96	106.30	8.06	5.2	2.65	1.50	21.1	.68	10.15	12.9	2.30	20.00	10.6	4.74
D oral	6	26	11.89	66.60	101.40	10.40	6.8	1.84	1.70	39.3	.74	14.00	15.7	4.00	26.50	14.3	4.83

Table 84. The average scores made by the Leal school groups, A, B, C and D on the original test and memory test in experiment eleven.

* per cent gain

The average scores made by the groups in the original test in experiment eleven show that the film group ranks below the oral group in each grade in every item of the test except the composition test in the fifth grade.

The oral group surpassed the film group in the sixth grade by 51.3 per cent in the question test, by 47.3 per cent in the chart test, by 46.5 per cent in the composition test and by 38.2 per cent on the total score.

In the fifth grade the oral group surpassed the film group by 31.6 per cent in the question test, by 5.5 per cent on the chart test, and by 7.5 per cent on the total score. The fifth grade film group was able to produce .65 ideas on the average more than the oral group, a difference of .5 per cent.

In general these results are the same as those reported in experiment nine. The factor which was not the same in the two experiments was the introduction of a different teacher into experiment eleven for the oral instruction, which only serves to extablish the superiority of the teacher situation on a more solid foundation.

The memory test scores show the oral group to be higher than the film group in the residual scores in the question, map, composition and total, in the sixth grade. On the other hand, the residual scores made by the film group in the fifth grade are higher than the oral group in the chart and composition score.

The per cent of loss made by the film group in the sixth grade is lower than the chart group in the question, chart, composition and total scores. In the fifth grade the film group recorded a gain of 8.8 per cent on the question score and a loss of only .8 of one per cent on the chart score. The oral group lost 40 per cent on the chart score and 16.7 per cent on the total score. The per cent of loss in every item of the test in both grades was less for the film group except the fifth grade composition score, which showed a loss of .2 of one per cent lower for the oral group.

It would appear that regardless of the length of the period between the original test and memory test that the groups which received pure film instruction retain more of what they learn than the groups which were exposed to any amount of oral instruction.

The attention analysis made by the writer's assistants during the two presentation periods shows that the attention in the film group was better than in the oral group. However, we find again that the film group did not pay one hundred per cent attention to the showing of the film.

The attention analysis which was made by the two assistants follows: --

ATTENTION ANALYSIS EXPERIMENT
ELEVEN

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
66	65	63	64	65	63	65	62	63	63	64	65	63	831	= 96.85 %
66	66	66	66	66	66	66	66	66	66	66	66	66	858	

Group B and D oral, fifth and sixth grade, Leal school, January 6, 1922.

Observer Miss Stuart

1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'		
67	67	67	66	67	67	67	65	66	67	67	60	68	861	= 97.39 %
68	68	68	68	68	68	68	68	68	68	68	68	68	884	

Group A and C film, fifth and sixth grades, Leal school, January 6, 1922

Observer Miss Neville

Note. The groups were together for the oral and film presentations; hence the large number of pupils in each section. The total number of pupils in attendance at the presentation is given.

CHAPTER X

Experiment Twelve

PROBLEM. The purpose of experiment twelve was to compare the amount of information gained from a single showing of a film with the information gained from a film presentation accompanied by oral explanation during the projection. This comparison checked the same comparison made in experiment eight.

DESCRIPTION OF THE EXPERIMENT. (1) *Subjects*. Groups "C" and "D" of the sixth grade Leal school were selected to act as subjects in experiment twelve.

(2) *Topic*. A film different from the one used in experiment eight was selected for experiment twelve. This film was the same as that used in experiment six, namely, "Canals in United States History."

The oral explanation served to explain the topic as it was developed by the film.

(3) *The presentation of the topic*. On January 17, 1922, group "C" sixth grade Leal school was assembled in the sixth grade room and received preliminary instructions as follows:

> "Today you will learn something of the influence of canals on United States History. How many know what a canal is? (Show of hands.) First you will hear a story about canals read, then you will see a film on the same topic. Pay strict attention to all you see and hear for you will be given a test to find out what you have learned about canals."

After the preliminary instructions were read to the group the following discussion was read. The time involved in reading this discussion was three minutes.

Discussion read ro groups
in experiment 12.

CANALS IN UNITED STATES HISTORY

Discussion

As every child knows, canals are ditches full of water, on which, unless made for irrigation, small boats are towed or propelled. Many people know nothing more about them. Many have not thought particularly of the reasons why canals were built in this country, or have never learned the great extent of the various canal systems in use three quarters of a century ago, nor indeed the importance of the canal systems in use today. Millions have never seen a canal used for freight traffic.

In developing a new country, settlements and trade routes follow coasts and rivers. If rapids or falls in the rivers check boat passage, cargoes have to be carried around such places by men or beasts. Such is usually called a portage. At all important portages where trade routes persisted after the pioneer days, canals having locks were built to allow passage. When larger vessels came into use, these canals were deepened and enlarged; some of them- as the Welland and the Sault Ste. Marie Canals- became internationally important.

In the earlier days of settlement the slow methods of carrying freight made the pioneers impatient. Horses were not plentiful and even a pack horse could carry little. Heavy wagons drawn by ox-teams, mules, or horses were extensively utilized where ocean, bay, or river would not serve; but even this conveyance on the best of roads was inadequate. It was necessary to take the products of the land and of the various small industries of the country to market and to distribute the goods from abroad to the interior districts. Therefore it was profitable to carry the larger loads on boats towed through canals, built from one section of the country to another. Thus goods in quantity could be transported to inland distributing centers in less time and with less expense than by wagon. There were many canal systems of this character, some of them having considerable short side canals, or feeders. The Cumberland Canal System (Chesapeake and Ohio), the Erie Canal System, and the systems in Pennsylvania, Ohio, Indiana, and Illinois, all had a marked effect on the commercial development of these districts in the first half of the nineteenth century. In fact, although this group was the outgrowth of conditions arising with exploration, its canals were for a long time more important and extensive than the earlier canals past falls and rapids, such as the Welland and the Sault St. Marie.

This inter-regional canal, eclipsed during the middle and latter part of the nineteenth century by the development of the railroad, has in the last thirty years experienced a great regeneration. The most conspicious example of a large canal system which has "come back" is the Erie Canal, partially remade and partially succeeded by the New York State Barge Canal System, which performs in a larger way the same functions as the old Erie Canal. Plans are being considered for the construction of immense new systems through territory previously served locally by older and smaller systems. Conspicuous examples are the Lakes-to-the-Gulf and the Great Lakes-St. Lawrence deep waterways. It is believed by supporters of the projects that if these canals are completed they will effect an immense saving in freight-carrying on many articles.

Immediately after the preliminary discussion the film was projected before the group. The film instruction consumed fourteen minutes.

The film as projected is described in experiment six.

Group D of the sixth grade Leal school followed group C to the sixth grade room and received the preliminary instruction which follows:-

> "Today you will learn something of the influence of canals on United States History. How many know what a canal is? (Show of Hands.) First you will hear a story about canals read, then you will see a film on the same topic during which oral explanations will be given. Pay strict attention to all you see and hear for you will be given a test to find out what you have learned about canals."

The three minute preliminary discussion read to group C was read to group D. This in turn was followed by the projection of the film during which oral explanations were given to the groups as the topic was developed. The period of instruction was fourteen minutes in length.

During each instruction period an assistant recorded the attention of the pupils to the presentation by estimating from minute to minute the pupils who were not paying attention.

(4) The Tests. The tests were administer immediately after the close of each instruction period.

These tests were two fold in nature calling first for answers to questions and second for map work. A description of the tests is given in experiment six, pages 236-237. The tests were the same as those used in experiment six and were administered and scored as described on pages 239-240.

The memory tests were given nine weeks later on March. 14, 1922.

THE RESULTS. The results of this experiment are shown in table 25.

Group	Grade	Number of pupils	Average chronological age	Average intelligence score	Average I.Q.	Average question score	M D	Aver. map score	M D	Aver. Total score	Mean Dev
D film-talk	VI	25	11.51	68.24	106.04	9.68	2.93	1.44	1.49	11.12	4.15
C film	VI	25	11.78	68.44	106.32	8.32	5.13	.92	.96	9.24	4.[illegible]3
			Memory test.		Nine weeks. March 14, 1922.						
D film-talk	VI	25	11.51	68.24	106.04	6.96	2.84	1.40	1.15	[illegible]	3.37
C film	VI	25	11.78	68.44	106.32	6.12	2.12	1.56	1.39	7.68	4.01
						% of loss		% of loss		% of loss	
D film-talk						28.10		2.78		24.82	
C film						26.45		69.56		16.89	

Table 25. The results of experiment twelve showing the average scores by the sixth grade groups C and D Leal school in the original test and memory test.

* per cent gain.

An examination of table 25 shows that the film-talk group D made a score on each item of the test higher than the film group C. This result is the same reported in experiment eight. Hence we find in two experiments making the same comparison, in two different schools, using two different films, that the same result obtains.

The film-talk group is superior to the film group by 16 percent in the question test, by 56 percent in the map test and by 20 percent in the total score.

The memory test reveals the same relationship between the two groups with the exception of the map score. Here, the film group records a gain of 69.36 percent. This large percent of gain is not unusual in view of the fact that the average score made was only 1.56 points.

The percent of loss is less for the film group than for the film-talk group in each item of the test. This result is the same as that reported in experiment eight. While explanations given during the showing of the film seem to enable the pupils to perform better in an information test they forget a larger percent of the material thus acquired than the instructed film group. However, the residual score for the film-talk group is still higher than that made by the film group with the one exception.

The assistant making the attention analysis became so interested in the film that her record was without value, hence it is not reported.

CHAPTER XI

Experiment Thirteen

PROBLEM. The films that have been described in the foregoing chapters contain a small percent of action pictures. This fact is demonstrated in chapter thirteen. Consequently the writer purposed to secure a film wherein motion was an essential part of the meaning of the pictures. Finally a film was found which served the purpose when parts of it were used.

The experiment was organized to compare the information gained by pupils from one projection of the selected parts of this film shown in motion, with the information gained from one showing of such scenes as still pictures. Such a comparison was made possible by the use of the American projector.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects.

Groups A, B, C, and F of the 5th and 6th grades Ideal school were selected to act as subjects in experiment thirteen.

(2) Topic. The film which was found to be suitable for experiment thirteen was entitled ~~"Steamboats~~ "The Steamboat in United States History." Only a part of the film was used. Captions marked 1, 2, 3, 4 in the film outline and scenes marked a, b, c, and d were selected from the film to form a new strictly action film. Scene a showed two men in a canoe paddling down stream, scenes b, c, and d showed models of the early steamboats in motion. The three latter pictures were of the animated cartoon type.

(3) Presentation of the Topic. On January 13, 1927, groups A fifth grade and C sixth grade, Ideal School, were

assembled in the sixth grade room and were given the following preliminary instructions:

> "Today I am going to show you some pictures of early steamboat models. I will run a scene through and then I will stop the film and you will see nothing on the screen for a few seconds then I will show you another scene. Pay attention to the screne at all times for I am going to give you a test at the end of the period to find out what you have learned about steamboats. Before I show you the pictures I am going to read a description of these steamboats to you."

The descriptive material read to the groups follows:

Discussion of Steamboats

In the pioneer days of this country the rivers were doubly valuable to the settlers. They not only carried the new settlers to their homes, but also became the natural paths of commerce. The settlers found much of their produce too bulky to transport by means of packhorses; but it could be floated down stream on flatboats or rafts. On the quiet rivers sailboats were used both up and down stream. For lighter loads and faster travel canoes were used. Water transportation nevertheless was crude and difficult, especially up-stream, for all early types of boats were to some extent man-propelled. So, if the downstream trip was a long one, the rafts and often the boats were sold for lumber and the return trip made in some other way. Settlers in western Pennsylvania and the Ohio territory, who would float downstream to New Orleans with their produce, and then go by sailboat with their exchange goods to some eastern port, from there taking wagons or packhorses across the mountains to the head-streams, whence they could traveldown-stream to their homes. The time and effort required by such long trips made a new motive power greatly desired. In consequence there were many experimenters with steam. John Fitch and Oliver Evans were pioneers in operating boats by steam.

Fitch's boat was operated by long paddles like oars which were operated in two sets on one side of the boat. While one set was in the water the other set was moving forward to be again dipped into the water on the return stroke. Thus the boat was propelled thru the water

by the alternate strokes of the two sets of oars.

Robert Fulton too experimented with steam for boats. His "Clormont" was different from Fitch's boat in that it had a paddle wheel on the side. This boat was the first commercially successful boat in this country.

Later "stern wheelers" or boats with the paddle wheel at the back were built for travel on smaller inland rivers. These boats helped build up the country by transporting goods and persons along the river routes throughout the country.

This morning I am going to show you pictures of these boats which I have just told you about. I want you to look at them so that you may see the differences between these early boats. Between each picture there will be a time of ten or fifteen seconds when the screen will be blank. This time is to allow for changing the pictures so do not let it disturb you. Give the pictures your closest attention, for I am going to ask you to write about what you have seen and heard.

The film presentation required four minutes of actual picture instruction. However, the instruction period was seven minutes long. The film had to be stopped at the end of each scene and caption for the same length of time it took to run through that scene or caption. This procedure was necessitated by the fact that when a scene or caption was shown to the other groups as a "still" the time consumed in running the film through the projector to the next caption or scene had to be duplicated in the film presentation. That is, during the still picture presentation, which was the same as a stereoptican slide projection, the scene was first shown still for the same length of time it took to show the scene while the film was running through the projector. Then the lens was covered and the film was run to the caption. The time interval involved in running the film to the next "still" caption or scene was duplicated in the film presentation.

The time intervals were determined by carefully timing the film at a set speed with a stop watch, scene by scene and caption by caption. Aided by an assistant the writer was able to start and stop the machine, after some practice, so that the time intervals were duplicated in each presentation. The assistant signaled the writer when to start and when to stop by timing each interval as previously determined with a stop watch.

The outline of the film follows:-

SCHOOLFILMS

History VIII

THE STEAMBOAT IN UNITED STATES HISTORY

Published by

Society for Visual Education, Inc.
Chicago, Ill.

Note.

The following captions and scenes were taken from the film by the above title for use in experiment twelve.

(Titles underlined.)

(1) In the early days, transportation by water was slow and laborious

(a) Picture shown of man propelled canoe.

(2) John Fitch proved (1787) that a boat could be propelled by steam power. His invention had paddles like oars.

(b) Picture of early model, animated.

(3) Robert Fulton built the first steamboat to achieve real commercial success the "Clermont" launched on the Hudson in 1807.

(c) Picture of animated model of "Clermont" shown

(4) The "Holyoke" a type of the stern wheel steamer built for inland rivers

(d) Picture of animated model.

Groups B and D of the fifth and sixth grades respectively were assembled in the sixth grade room after the instruction of groups A and C was finished. The preliminary instructions read to groups B and D follow:-

> "Today I am going to show you some pictures of early steamboat models. Part of the time the screen will be blank while I am getting ready for the next picture. Pay attention to the screen at all times for I am going to give you a test at the end of the period to find out what you have learned about steamboats. I am going to read a description of these steamboats to you."

The descriptive material read to the groups was the same as that quoted above.

The four captions and four scenes were then shown to the groups still, the instruction period lasting seven minutes.

Drawings of the three steamboat models copied from the film are reproduced here by photographs taken of those drawings.

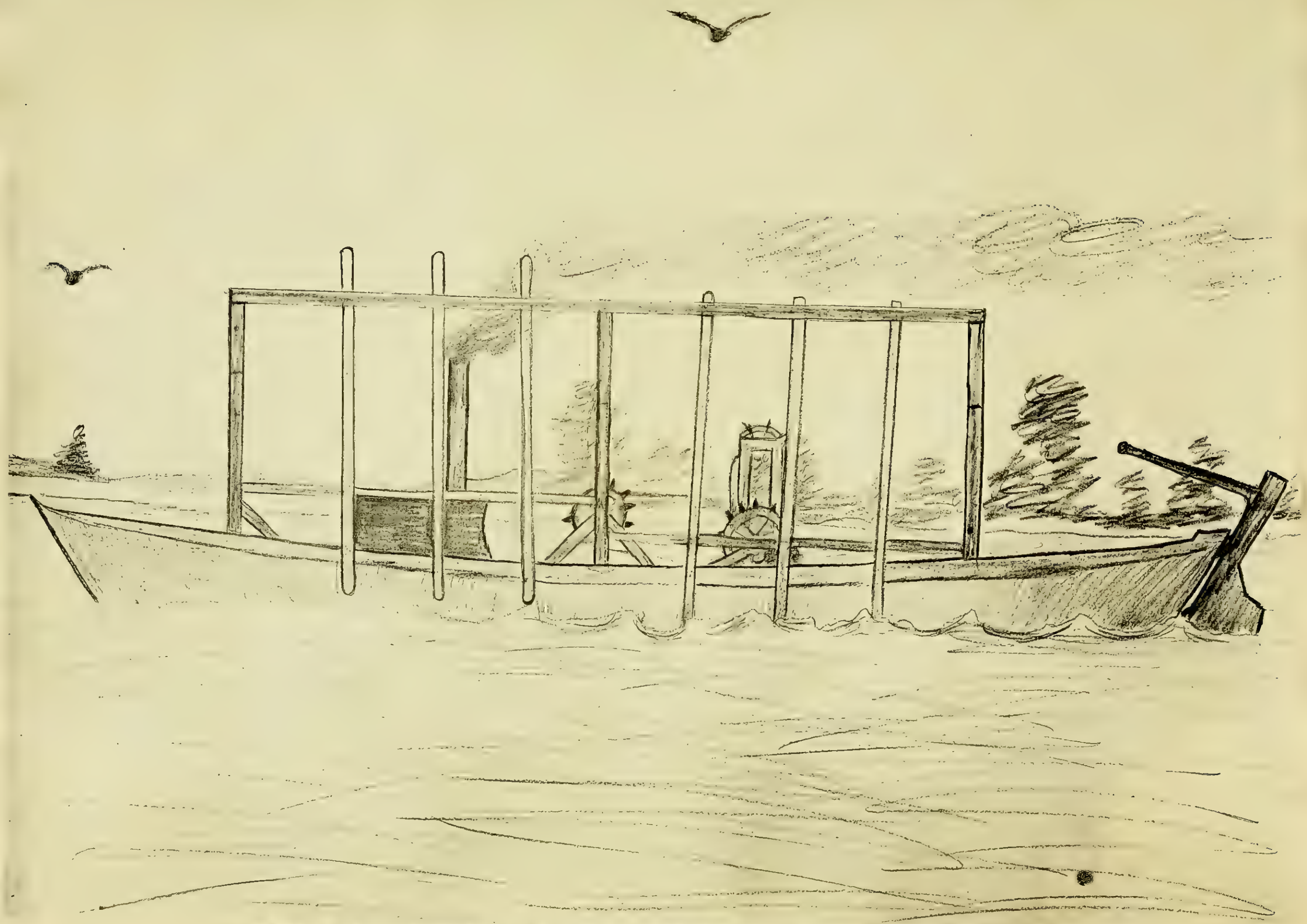
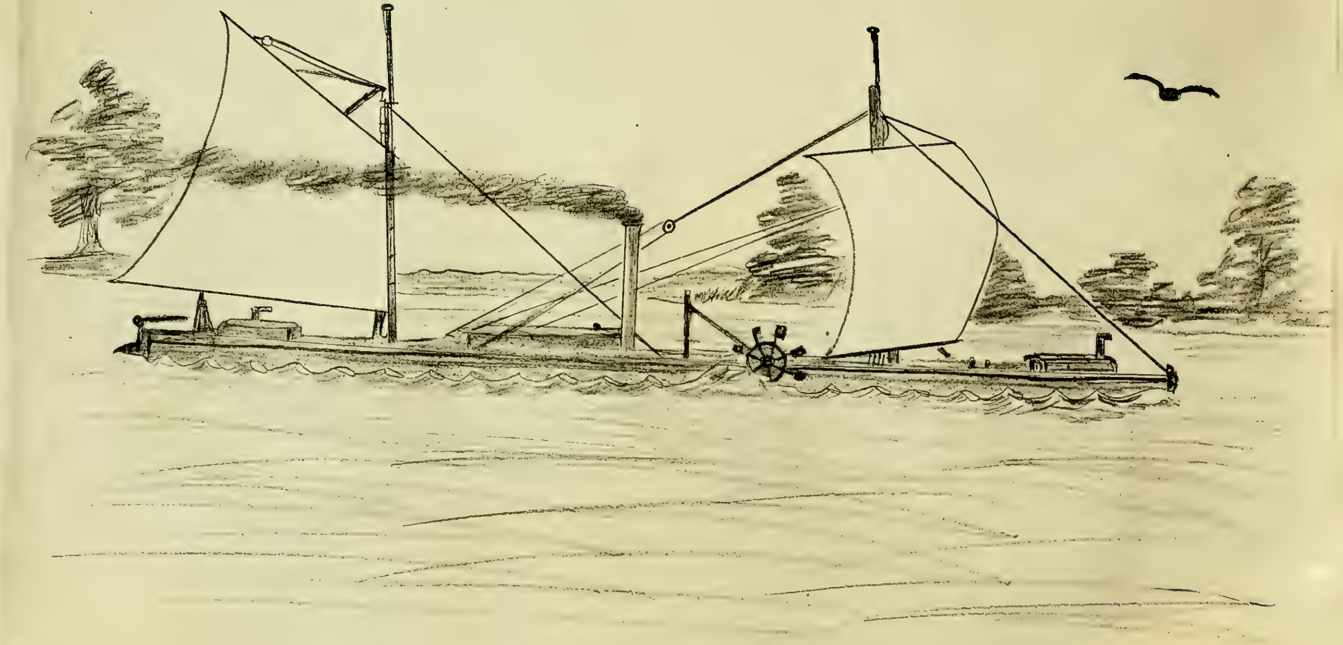


Chart 14. A model of John Fitch's early steamboat.



Clermont - Fulton

Chart 15. Fulton's Clermont.

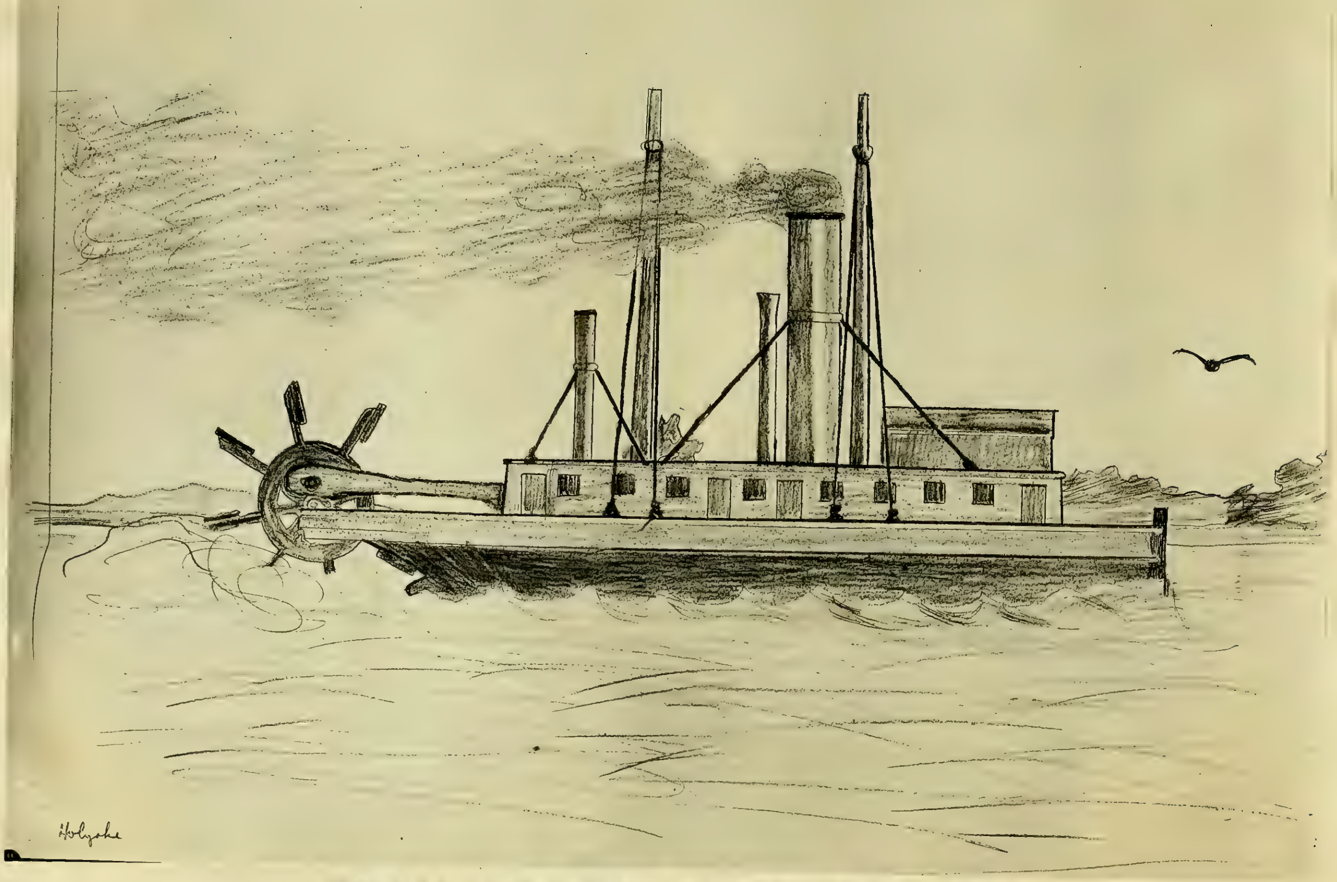


Chart 16. The Holyoke a type of river steamer.

(4) The Test. After each presentation period the groups resumed their seats and were given a three fold test covering the instruction just received. The test consisted of questions, statements asking the pupils to write descriptive paragraphs, and drawings of the models. The pupils however failed to write more than one or two sentences for the descriptive paragraphs hence the question score and "composition" score was lumped together in the final tabulation.

The preliminary instructions given each group before taking the test are as follows:-

> "First write your name on each sheet, then put your grade and the date on the first sheet. Answer as many of the questions as you can by filling in the blank spaces. You will be given time to finish."

The memory tests were administered 10 weeks later on March 24, 1922. The pupils remained at their own seats and the following preliminary instructions were read to each room by the writer:-

> "How many remember the Steamboat pictures which I showed you some weeks ago? (Show) of hands.) Today I am going to give you a test to see how much you remember about the steamboats. Write your name on each sheet, then put your grade and the date on the first sheet. Answer just as many of the questions as you can."

The question tests were scored by the writer's assistants a first time and rescored a second time at a later date. The questions and answer key used in experiment thirteen follow.-

Steamboats

Name________________________ Grade________ Date________

1. In the early days of settling America water travel was slow and laborious because the settlers had to use canoes most of the time. Describe a canoe in detail. Draw a picture of a canoe on the back of this sheet.

2. Have you ever seen a canoe? ______ 3. Where did the men sit in the canoe in the picture?________

4. Where in the canoe do they put their goods and things when paddeling down the river?___________

5. How does one make a canoe go thru the water? (Tell just those things a person must do to make the canoe move.)

6. Who proved for the first time that boats could be propelled thru the water by a steam engine?______

7. At what date did he do this?____________________

8. Describe this first steamboat in detail in the space below. Draw a picture of this boat on the back of this sheet.

Steamboats -- 2

Name ____

9. How did the engine make this first steamboat move thru the water? ______________________________

____

____

____

10. How many sets of paddels or oars were on this boat?

____

11. How did these paddles work to make the boat go forward?

12. When did RobertFulton's boat the Clermont make its successful trip? ______________________________

13. In the space below describe the Clermont in detail. (Draw a picture of it on the back of this sheet.)

14. What made the Clermont move thru the water? (1) ____

________________ (2) ______________________________

15. Where were the paddles on the Clermont located? ____

____

16. How would they make the boat go thru the water? ____

____

17. How did the paddles on the Clermont differ from those on the first steamboat? ______________________________

18. Would the Clermont be able to go if the engine broke down? ______________ How? ______________________________

Steamboats -- 3

Name____

19. The Holyoke was built for inland rivers. Describe this third steamboat in detail. Use the space below. (Draw a picture of it on the back of this sheet.)

20. How did the Holyoke differ from the first steamboat?

____

____

____

21. How did the Holyoke differ from Fulton's Clermont?

____

____

____

22. How did the Holyoke go thru the water? (Tell just what made it move and why.)

23. Where was the paddle wheel on the Holyoke?________

____

24. Have you ever seen a steamboat?_______________

25. If you have seen one where did you see it?________

______________________When?______________

Correct answer key used in experiment thirteen. The point value of each question in brackets. A question mark in a bracket means that the value of that question depended on pupils fertility of description.

(?) 1. One point given for each idea used in describing a canoe correctly.

Drawing (6) The drawing of the canoe; score one point for each of the following items reproduced in their correct relationships, man in front of canoe, man in stern, goods in middle, canoe, paddle in front, and paddle in rear.

2. Yes or no. (no score for this item)

(1) 3. On in each end of the canoe or one in front and one behind.

(1) 4. In the middle of the canoe

(?) 5. One point for each idea correctly describing the action.

(1) 6. John Fitch

(1) 7. 1787

(?) 8. One point for each idea used in describing Fitch's boat. (Refer to chart.)

(8) Drawing:- score one point for each of the following items reproduced in their correct relationships, front set of paddles, rear set of paddles, engine, smoke stack, smoke, cabin, rudder, and the boat.

(?) 9. One point for each idea used in describing the action

(1) 10. Two

(1) 11. Back and forth in a circular motion or up and down in a circular motion.

(1) 12. 1807

(?) 13. One point for each idea used in describing the Clermont.

(12) Drawing:- score one point for each of the following items reproduced in their correct relationships, paddel wheel, paddels on wheel, front mast, front sail, stern mast, stern sail, cabin, engine, smoke stack, smoke, boat, and rudder.

(2) 14. (1) paddle wheel or steam engine moved paddle wheel
(2) Sails

(1) 15. On wheel at side of boat.

(1) 16. By going round and round through the water.

(1) 17. Paddle wheel instead of long oars.

(2) 18. Yes, by sails.

(?) 19. One point for each correct idea expressed in describing the Holyoke.

(10) Drawing;- score one point for each of the following items reproduced in their correct relationships; paddle wheel, driving shaft, engine, cabin, smoke stack, smoke, mast, rudder, and boat.

(1) 20. Had paddle wheel at back instead of long oars.

(2) 21. (a) Holyoke had paddle wheel at back and (b) no sails.

(?) 22. One point for each idea correctly expressing the action.

(1) 23. At back

24. (no score)

25. (no score)

- -

Total score 54 points

Drawing score 36 points

(Note:--

The descriptive paragraphs were intented to serve as a controlled composition test. However, the pupils spent most of their time on the drawings and wrote only a sentence or two if anything at all in answer to the descriptive exercise. Questions 2, 23, and 25 were intended to help the writer analyze the responses in terms of the previous experience of the pupils with steamboats. This analysis did not prove profitable.)

THE RESULTS. The average score made by each group in the three fold test is shown in table 26 .

Original Test, January 13, 1922. Leal School, Urbana, Illinois

	grade	pupils	average chronological age	intelligence test score	intelligence quotient	average score questions		M I	average score drawing		M I	average score T.S.		M
Film-A	5	19	10.16	52.13	104.[illegible]7	10.37		[illegible].82	8.37		[illegible].97	1[illegible].74		[illegible].14
Slide B	5	19	10.66	52.31	102.1	8.00		[illegible].79	6.16		3.03	14.16		5.11
Film-[illegible]	6	20	11.63	70.49	108.18	14.[illegible]5		[illegible]	11.70		[illegible]	16.03		1[illegible].6
Slide [illegible]	6	20	11.74	7[illegible].95	107.8	1[illegible].35		[illegible].41	7.7		4.10	[illegible].05		7.66
		Memory test		March 24, 1922			% loss			% loss			% loss	
Film-A	5	19	10.16	[illegible]	10[illegible]	10.[illegible]	1.3	[illegible].91	7.7[illegible]	1[illegible].10	4.40	17.82	[illegible]	718
Slide B	5	19	10.66	[illegible]	102.1	7.10	11.[illegible]	[illegible].96	6.6[illegible]	[illegible].4*	5.32	13.70	[illegible].70	6.45
Film-[illegible]	6	20	11.63	70.49	108.18	1[illegible].[illegible]0	14.[illegible]	[illegible].70	[illegible].9	13.4	[illegible].94	[illegible].[illegible]0	14.0	7.[illegible]
Slide [illegible]	6	20	11.74	70.95	104.3[illegible]	11.80	[illegible]	.75	7.72	.6*	4.7[illegible]	13.85	1.6	[illegible].[illegible]5

Table 26. The results of experiment thirteen. *Increase

The film group in both grades made higher scores in each item of the test. In the fifth grade the film group which saw the action pictures made a score 2.37 points or 29.6% higher than the slide group on the drawing and 4.58 points or 35.8 % higher than the slide groups total score. In the sixth grade these differences are 2.00 or 16.2 % 4.00 or 51.9 % and 6.00 or 29.9 % respectively in favor of the film group.

The memory test residual scores show that the film group is again higher in each item of the test in both grades. The per cent of loss in the total score in both grades is lower in the slide group than in the film group, the per cent of loss on the other items is irregular when compared group to group and grade to grade. This is significant and taken with the previous experiments would seem to indicate that a greater per cent of loss is to be expected in the group making the higher score, perhaps because they excell in the more difficult parts in the first tests.

All of the per cents of loss are small in view of the fact that the tests were given ten weeks after the original test. The two slide groups even recorded a slight per cent of increase in the drawing test which may be due to their checking up on their first answers with other children in the experiment.

CHAPTER XII

Experiment Fourteen

PROBLEM. The final experiment purposed to obtain from pupils evidence of their ability to secure information from a unit of geography taught with the aid of stereographs, as compared with the information gained from the same unit taught with the aid of stereoptican slides.

DESCRIPTION OF THE EXPERIMENT. (1) Subjects. Groups C and D, sixth grade were used as subjects for experiment fourteen.

(2) Topic. The unit taught was "The Middle Atlantic States" which was the next topic to be studied in the sixth grade geography classes at the time the experiment was launched.

The slides and stereographs were selected from the Keystone "600" set, each stereograph being duplicated in the corresponding slide.

(3) The presentation of the topic. The principal of the Leal school, Miss Wiley, conducted the instruction of each class during the entire period of the experiment. The stereograph group C started its study period at one thirty in the afternoon. Study questions prepared by Miss Wiley for each day and the text assignment, served as a basis for the pupils' study which was supplemented by the Keystone stereographs assigned to that day's work. The study period was followed

by the recitation period each period being 20 minutes in length.

The study period was supervised by Miss Wiley. Seventeen copies of each stereograph were available making one stereograph to each stereoscope and one stereoscope for every two pupils. The stereographs were loaned for the experiment by the Keystone View Co.

Group I started its study period at two o'clock and studied the questions outlined by Miss Wiley and the text assignment for that day. Their study material was not supplemented by any pictures except those in the text. The question and text assignment was the same for both groups each day. This study period was supervised by the other sixth grade teacher Miss Coombs.

The recitation period for group I followed the study period. The recitation was conducted by Miss Wiley and the day's work summarized with the aid of the Keystone stereopticon slides.

Complete stenographic reports were made of each recitation. The first recitation one stenographer covered the material but this was found to be difficult so the following recitations two stenographers were present one covering the teacher's remarks, the other taking the pupils' statements. Seating charts were made of each group by the stenographers which aided them in reading back their notes.

The writer is indebted to the Bureau of Educational Research of the University of Illinois for the services of these stenographers.

The experiment lasted nine school days, from February 27, to March 9, 1922. The first seven days were spent on the study of the Middle Atlantic States, the last two were test days.

The study questions showing the assignment, the text book assignment and "picture" assignment are given in the following outline:

Study Questions Used by Pupils in Experiment Fourteen.

Text, Brigham, and McFarlane's
Geography Book II

Pages 73-77
Stereographs
and
Slides
Numbered 26,
48, 61, 50,
61, 48,
48.

Compare middle Atlantic States in size with Colorado.

What 3 advantages have these states for transportation?

Name 4 physical regions here.

What mountains are in Appalachian highland?

Atlantic Lowland includes what parts of what states?

What names has the Appalachian plateau here?

Where is the highest part of the group?

Why are lake plains so fertile?

By what 4 rivers is this group drained?

Show where each river rises and into what each flows.

Use pictures to see the surface in different parts and what the rivers are like. Are they young or old rivers?

Pages 77-80

Stereographs
and
Slides
Numbered
51, 47, 72, 53
44, 57,
46, 45, 50

What is the difference between light and heavy soils?

What 2 things happen to make soil?

What difference in way soils of New York and the northern part of other states and southern part were made?

What things must a farmer know in order to get good results from his soil?

Tell of climate as to winds, temperature, and rainfall. Why have New York and Philadelphia heavy fogs?

What crops are raised on farms?

Show how much wheat they raise and how much they buy in New York if 6,000,000 people live there.

Where are fruits and vegetables raised. Can you tell why?

Which fruits are most important; name a special crop for each state.

What 3 branches of agriculture are common near the cities?

Pages 81-84
Stereographs
and
Slides
Numbered
74, 75, 76, 77,
78, 79,
69,70,42

Show how much coal is made.

What is the difference between bituminous and anthracite coal?

Where is pennsylvania is each found?

Where is each used? Can you see why?

What city or cities is in each district of mining?

How do we get petroleum? What products are made from it?

From map p 83 find where petroleum and gas are found.

Where is some iron found here? Where does this region get iron ore for factories?

How and where is salt obtained?

Where is each of these found:- clay, cement, rock, mable, slate ?

What is made from the clay?

What is the difference between hydraulic and Portland cement?

Pages 65-91

Stereographs

and

Slides
Numbered

25, 26, 27, 28, 29

30, 32, 31, 34, 35

51, 39, 45, 46, 37

40, 41, 42, 48, 60

81, 82, 84, 83, 61

What are 2 chief trade routes?

What makes each so important?

Give 2 reasonswhy New York has grown
to be our largest city?

What or where was New York at first? What is
it now?

On Fig. 135 p. 65 find these places; also
notice East River.

Tell of number of people in New York City.

Tell of transportation in New York City. For
what is Manhattan most used?

Where does New York's coasting trade reach?
What industries are important in this city?

Tell of 3 kinds of homes here.

What is a barge canal? How were journeys
once made between New York and Buffalo?

What shows importance of main route between
the cities?

Write beside each of these cities what it
is noted for - then study your list:

Yonkers - sugar, carpets, elevators

Albany - capital

Troy - collars and cuffs

Cohoes - cotton knit goods

Schenectady - locomotives, electrical supplies

Gloversville) gloves
Johnstown)

Utica - cheese

Syracuse - typewriters, auto supplies
implements

Rochester - Photographic supplies

What products are sent to and through Buffalo?

For what is [illegible] noted?

Of what use are Niagara Falls?

Pages 91-95

Stereographs

and

Slides

Numbered

52, 53, 54, 55,

56, 59, 60

For what are the cities of northern New York noted?

How are cities in southern New York reached?

What industries do they follow?

How does location of Philadelphia help it?

How is it noted historically?

What industries has it?

How has road from Philadelphia to Pittsburgh been used at different times? What kinds of surface do you pass in going from Philadelphia to Pittsburgh?

Tell of Pittsburgh as to location, how named, materials near it for work, where other material come from.

How is coke made?

How is iron obtained from the ore? How is steel made?

What is the difference between pig iron and wrought iron?

What other product is made at Pittsburgh? Why?

Beside each city write what it is noted for; find the cities on your map.

Erie Wilkes-barre Easton

Williamsport Scranton Chester

Where do most of the people live in New York Jersey? Why?

Why are Hoboken and Jersey City important?

Gieve 2 reasons why Bayonne is noted?

Find what is made at Paterson, Trenton, Camden, Newark.

What summer resort is in New Jersey?

What is Princeton known for?

(4) *The Tests.* On March 8th, the day following the last recitations on the Middle Atlantic States, parts one and two of the test were administered to the pupils. Part one was a map test consisting of ten questions. Each pupil was supplied with a hectographed outline map of the Middle Atlantic States on which he recorded his responses. Part two was intended to be a controlled composition test involving the picture material only. Part two failed to function as the writer hoped it would, in fact the pupil's responses were so short that the test was anything but a composition test. Evidently parts one and two given together made the test period too long. The writer finally threw part two out of consideration in the results.

Part three was administered the second day, March 9th. The exercises in part three were taken directly from the stenographic report of the instruction. The eighty exercises were selected from one hundred twenty five exercises and were mimeographed on four sheets. The writer gave part three to both groups. Each page was given separately as a time test.

A sample of each part of the test follows including the preliminary instructionsgiven and the scoring key used to score the papers.

Part I

Preliminary instructions:

> "Today I am going to give you a test to find out what you have learned about the Middle Atlantic States. Write your name, date, and teacher on the question sheet and map sheet. Answer your map questions on the map. Put the answers to Part II on the back of your first sheet. Do the very best you can. You will be given time to finish."

Sample of Test

Name____________________ Date____________ Teacher__________

PART I

Map Work

1. On your maps name the states of the Middle Atlantic group.
2. Name the rivers and lakes that form parts of the boundaries of these states.
3. Locate the Erie Canal showing where it runs by a line.
4. Locate the following cities: New York, Philadelphia, Rochester, Buffalo, Trenton, Scranton, Pittsburgh, Utica, Jersey City, and Syracuse.
5. Locate the capital of each state.
6. Locate the mountain ranges in the Middle Atlantic States.
7. Locate the Lake Plains in New York.
8. Name and locate the principal rivers.
9. Name and locate three of the main industrial regions in each state.
10. On your maps show where soft coal, hard coal, and oil are to be found.

PART II

Write a full description--
Information from your pictures. just as much as you can.

1. Give an account of the milk supply of the city of New York.
2. Tell how an oil well is "shot".
3. Describe how sugar is put in big sacks ready to be shipped.

4. Describe the process miners use to get coal out of the ground.

5. Describe the boy scout and camp fire girls' activities in truck farming.

6. How do we get table salt? Describe the process.

7. What is pig iron? Where is it made and how do they produce it?

8. How does New York compare in fruit raising with other states?

9. Describe the process of making coins at Philadelphia.

10. Describe the means of transporation out of the city of New York.

SCORING KEY
PART I

Answers.

1. New York, Penn., New Jersey.
2. Lake Erie, Ontario, Champlain and St. Lawrence river and Delaware river.
3. As located on map
4. "" """ "" ""
5. "" "" "" ""
6. Adirondack, Catskill, Blue, Alleghany, Appalachian mts.
7. As located on map
8. Ohio, Allegheny, Monongahela, Hudson, Genesee, St. Lawrence.
9. As located on map

Scoring Key for Parts I
and II for the Test in
Experiment Fourteen

Part I

Give one point for item correctly located, and named as called for in the 10 exercises. Refer to maps in the text.

Part II

Give one point for each idea correctly describing the process called for in the exercises. (The above scheme was found unsatisfactory and the number of written words counted after all irrelevant material had been crossed off was tried in the attempt to score the responses. This latter scheme failed to satisfactorily solve the problem. The writer found it hard to make something out of almost nothing so discarded Part II. Moral: always be sure the pupils know exactly was is expected of them.)

Part III

Preliminary instructions:

> "Today's test on the Middle Atlantic States is a time test, that,is, you will only have a certain time in which to answer the questions. Pass the papers face down one to each pupil. . . Everyone have your pencil ready and when I say "Go" turn the paper over and answer as many of the questions as you can until I say "Stop." If any finish before I say "Stop" raise your hand. Do not write your name on the sheet until I tell you to. Are you ready? . . . Go. (First

pupil was through in 2 min. 25 seconds.) At 2 minutes and 30 seconds the writer said "Stop."

"Now we are ready for the second page. Write your name, date, and teacher on the first page and turn it over on your desk. Pass the papers face down over to each pupil.......Everyone have your pencil ready and when I say "Go", turn the second paper over and answer as many of the questions as you can until I say "Stop." If any finish before I say "Stop" raise your hand. Do not write your name on the sheet until I tell you to. Are you ready?..."Go". (First pupil was through in 2 minutes and 50 seconds.) At 3 minutes the writer said "Stop." Write your name on the second sheet.

"Now we are ready for the third page. (Papers passed face down) You all know what to do now. Are you ready?.....Go!(First pupil was through in 2 minutes.) Writer said "Stop" at 2 minutes and 15 seconds. Write your name on the third sheet.

"Now we are ready for the last page. (Papers passed face down.) You all know what to do now. Are you ready?...Go. (First pupil was through in 2 minutes and 20 seconds.) At 2 minutes and 30 seconds the writer said "Stop." Write your name on the last sheet. Fold the four sheets together through the middle and pass them forward to the front desk. Verne will you collect the papers?"

The answer key to Part III follows. The point value of each question is put in brackets to the left of the question.

Score Key

Name---------------------Date ----------------Teacher-------------

Point
Value

(3) 1. The Middle Atlantic States are: (New Hampshire, Vermont, [✓ New Jersey], Connecticut, [✓ New York], Rhode Island, [✓ Pennsylvania], Minnesota.)

(2) 2. They have the (Mississippi River, Ohio River, [✓ Atlantic Ocean], Pacific Ocean, [✓ Great Lakes]) for transportation.

(1) 3. The(Andes, [✓ Adirondack], Ozark)Mountains are in the state of New York.

(2) 4. Are the Lake Plains fertile?(Yes-No) If so, why? Accumulation of good soil washed down by rivers.

(1) 5. The([✓ Hudson], Delaware, St.Lawrence)river rises in New York,flows into New York Bay.

(1) 6. The Genesee river flows into(Lake Erie, [✓ Lake Ontario], Lake Huro

(1) 7. The Gennesee river rises inthe state of(Delaware, New York, [✓ Pennsylvania.])

(1) 8. The Susquehanna river flows into(Hudson, [✓ Chesapeake], New York Bay.)

(1) 9. (Syracuse, [✓ Buffalo], Philadelphia) is located on Lake Erie.

(1) 10.The Hudson River valley is __________(wide-[✓ narrow])

(2) 11.In eastern Pennsylvania the coal is very(soft-[✓ hard]), and in the western part,([✓ soft]-hard).

(2) 12.([✓ California], Colorado, Kentucky) raises the most muskmellons and New York, New Hampshire, [✓ New Jersey])ranks third.

(1) 13.It takes(clay, [✓ sandy], rocky) soil to grow muskmellons successfully.

(3) 14.Lake Erie and(Lake Ontario, St.Lawrence River, [✓ Hudson River]) are connected by([✓ Erie Canal], Suez Canal, Panama Canal.)

(2) 15.The(Delaware, Kaskaskia, [✓ Allegheny]) river and(Susquehanna, [✓ Monongahela], Genesee)river are parts of the Ohio River.

(2) 16.Light soil is (rocky, lumpy, [✓ sandy]) and heavy soil is([✓ clay], black dirt, sandy.)

(1) 17.If soil is wet, it must be (plowed, [✓ drained], irrigated) before cultivating.

(1) 18.A farmer must also know how to (disinfect, [✓ fertilize], sterilize soil.

(2) 19.If the winds come from the ocean they bring (sunshine, hail, [✓ rain]) and ([✓ warm], cool, freeze) the land.

(1) 20.The rainfall in the middle Atlantic States (medium, light, [✓ heavy])

32 Total points

Name ______________________ Date ____________ Teacher ______________

(2) 21. We find fogs in ([✓ Philadelphia], Pittsburg, Scranton) and (Boston, [✓ New York City], Trenton.)

(2) 22. The moisture in the winds from the ocean, strikes the cold land, (evaporates, [✓ condenses], freezes) and forms (hail, snow, [✓ fog].)

(7) 23. The farmers in these states grow ([✓ barley], [✓ rye], straw, [✓ wheat], rice, [✓ oats], flax, [✓ corn], [✓ hops], [✓ buckwheat], hay.)

(2) 24. They raise about (5, 10, [✓ 1]) bu. of wheat for each person and buy (10, [✓ 5], 20) bu. for each person.

(6) 25. They raise the following fruits: 1 ([✓ grapes], bananas, [✓ apples]) 2 (oranges, apricots, [✓ muskmellons]) 3 (grape fruit, [✓ peaches], blackberries) 4 ([✓ quinces], [✓ strawberries], plums)

(2) 26. The special products of New York are 1 (barley, wheat, [✓ hops]) 2 ([✓ onions], garlic, spices)

(2) 27. (Poultry, cheese, [✓ dairying], [✓ truck farming], fruit growing) are the two branches of agriculture close to the city.

(2) 28. The ([✓ Boy Scouts], Red Cross, Soldiers) and (Girl Scouts, School Girls, [✓ Camp Fire Girls]) were hoeing the school gardens in one picture on gardening.

(2) 29. Coal is made by (heat, [✓ pressure], cold) and (rocks, marshes, [✓ decayed vegetation])

(1) 30. Soft coal is (anthracite, [✓ bituminous]) coal; hard coal is ([✓ anthracite], bituminous) coal.

(1) 31. (Hard, [✓ soft]) coal has more gas.

(1) 32. (New York, Boston, [✓ Scranton]) is a city in the hard coal region.

(1) 33. We get petroleum by (digging, [✓ drilling], blasting)

(3) 34. (Dynamite, [✓ vaseline], coal gasoline, [✓ kerosene], glycerine, [✓ candles], iron) are made from petroleum.

(1) 35. Most of our iron comes from (New York, [✓ Pennsylvania], New Jersey.)

(1) 36. We get salt by letting water (condense, [✓ evaporate], dissolve) from salt water.

(1) 37. The two systems are by ([✓ sun], rain, air) and (running water, drilling, [✓ boiling].)

(1) 38. We find clay along the (Ohio River, [✓ Hudson River], Delaware River) valley.

(1) 39. We make (stoves, [✓ bricks], coal) from clay.

(1) 40. We find slate mixed in with the (iron, [✓ coal], clay).

38 Total points

Name ____________________ Date ____________ Teacher ____________________

(2) 41. Portland cement is made of (iron, black mud, clay) and(marl, salt, glue.)

(1) 42. Hydraulic cement is (artificial, natural, manufactured) cement.

(2) 43. The breakers, in the mine, (break, twist, destroy) the coal and remove (slate, iron, rocks.)

(1) 44. Little boys used to pick out (iron, slate, chaff.)

45. ~~[illegible]~~

(1) 46. In the picture on oil wells they poured (gasoline, nitroglycerine, kerosene) into a big (machine, pipe, hole) and then they put a (bow weight, dynamite) down this, which caused it to (explode, lift, pump).

(3) 47. The 3 chief cities in these states are (1. Albany, Philadelphia, New York) (2. Scranton, Syracuse, Pittsburg) (3. Buffalo, Troy, Boston).

(1) 48. The first part of New York was (Bronx, Manhattan, Queens).

(5) 49. The five parts of New York are (1. Ellis Island, Manhattan Island) (2. Queens, Troy) (3. Richmond, Wheeling) (4. Erie, Bronx) (5. Long Island, Atlantic City).

(1) 50. (Sandy Hook, Staten, Ellis) Island is an important island just south of Manhattan.

(1) 51. (Sandy Hook, Staten, Ellis) Island is at the mouth of the Hudson River.

(1) 52. This island is used to take care of the (sick people of New York, foreigners who come to our country, paupers of New York.)

(1) 53. Wall Street is known for (agricultural, protective, business) reasons.

(1) 54. It is called Wall Street because (Indians, Settlers, Wise men) built a wall to protect themselves from (British, French, Indians).

(1) 55. An immigrant must have enough money to (support a wife, support a family, support himself) until he (can meet his freinds, can find a job, can write English.)

(1) 56. One of the biggest New York industries is (glass making, sugar refining cloth making).

(1) 57. The ladies (knit, sew, tear) the tops of sugar sacks.

(1) 58. Sugar comes into this country as a (manufactured, raw, ripe) product.

25 Total points

(1) 59. In western Pennsylvania besides other industries, we have that of making (plate glass, cut glass, colored glass).

(1) 60. The workmen in glass factories have long handles on their tools because the (heat is so intense, cold is so intense, buildings are so narrow).

(1) 61. The melted material is put on tables to (cool, warm, dry).

(1) 62. The workmen in a dairy have on (black, white, brown) caps and suits.

(1) 63. Every man must have his hands thoroughly (washed, stained, dirty) before he milks each cow.

(1) 64. Milk is (disinfected, pasteurized, sterilized) by heating in big tanks.

(1) 65. Butter is made in a (churn, boiler, freezer).

(1) 66. The rough highlands along the Hudson River are called (rocks, Palisades, mountains).

(1) 67. The military school on the Hudson River is called (Western Military Academy, West Point, Culver).

(1) 68. Lackawanna is noted for (largest steel works in the world, largest coal mines in the world, largest shoe manufacturing company.)

(1) 69. Glaversville and Johnstown are noted for (glove making, stocking making, shoe making).

(1) 70. Utica is in a (high, level, rocky) region.

(1) 71. Schenectady is noted for (steel works, electrical works, glass works).

(1) 72. Rochester is noted for the largest (photographic, salt, potato) supply in our own country.

(1) 73. (Palm Beach, Atlantic City, Hoboken) is a summer rosort in New Jersey.

(1) 74. (Yale, Harvard, Princeton) is a school in New Jersey that you have read of).

(1) 75. Pig iron is sent to the factory to be (hammored, melted again, cut) to remove (coal, impurities, gas).

(1) 76. The metal is poured into (boxes, barrels cars).

(1) 77. After the impurities are out it is called (tempered steel, wrought iron, steel).

(1) 78. Sometimes these steel bars have to be (cut, chiseled, sawed) in two. The machine is called the (buzz saw, chisel, knife).

(1) 79. The Liberty Bell was made and shipped from (Paris, London, Holland).

(1)80. It(did not sound,cracked,broke to pieces) the first time it was used.

66 Total

THE RESULTS. The regularity of attendance of the pupils in groups C and D was somewhat broken during the experimental period on account of an influenza epidemic which visited Urbana the first week of March. Only pupils who had been regular in attendance were considered in the final results. The final tabulation of scores in the equalized groups after absentees had been thrown out is shown in table 27.

Group	Grade	No. of pupils	Ave. chronological age	Ave. intelligence test score	Average I. Q.	Ave. map score Part I	Mean deviation	Ave. question score Part III	Mean deviation
C Stereograph	VI	20	11.66	69.97	107.40	18.00	6.40	60.15	16.52
D Slide	VI	20	11.68	69.90	106.90	15.85	6.44	58.65	16.55

Table 27. The average scores made by Groups C and D in Experiment Fourteen.

An examination of table 27 shows that the stereograph group C made higher scores than the slide group in Parts I and III of the test. The stereograph group made a score 13.56 percent higher than the slide group in the map test Part I and a score 2.70 percent higher than the slide group in the question time test Part III.

The difference between the two groups in Part I of the test is large enough to indicate that the method of using the slide to summarize the study and recitation periods is not as effective as the use of stereographs during the study period to supplement the study and serve as an aid to discussion during the recitation. The difference between the two groups in Part III of the test is not large enough to be of any significance. The mean deviations in Part III test scores are not as high as they appear when one considers the fact that the total possible score on the test was 117 points.

These differences are only indicative of what is the fact of the case for the size of the groups is small. Furthermore, other factors might be found in future experiments to account for the differences found here.

CHAPTER XIII

The contents of educational films.

The seven films which were used in the foregoing experiments were analyzed in terms of their content by a measurement of the footage devoted to captions and scenes.

Five classifications of the content of these films were determined as follows:

(1) Captions--The explanatory language or printed material which appears from time to time during the film's presentation. The footage included under "captions" is that wherein only the printed matter appeared.

(2) Still pictures--Scenes, pictures of old prints, aeroplane scenes, scenes of streets and scenes taken from a train were included under "still pictures." Also pictures wherein motion was not shown except as the camera was in motion.

(3) Action pictures.--Pictures and scenes wherein action and motion were

shown as an essential part of the picture were classified as "action pictures."

(4) Animated cartoons and maps.--Cartoons, maps, charts or drawings of the animated type were classified as, "animated cartoons and maps." These generally contained animated explanatory printed material.

(5) Still cartoons and maps.--Same as classification four except that the maps, cartoons etc. were not animated.

An accurate measurement of the footage of each film according to the above classifications was made by the writer in the laboratory of the Society of Visual Education. These measurements and the per cent of the total footage of each film devoted to each classification were then tabulated as shown in table 28 .

Title of film		Captions	Still pictures	Action pictures	Animated cartoons, maps	Still cartoons, maps	Total
Life History of the Monarch Butterfly	No. feet	153	119	388	0	0	660
	per cent of total	23.18	18.03	58.79	0	0	100
French Explorations in North America	No. feet	152	71	97	410	4	734
	per cent of total	20.71	9.68	13.21	55.85	.55	100
Canals in United States History	No. feet	308	97	46	382	0	833
	per cent of total	36.98	11.65	5.52	45.86	0	100
Panama Canal and its Historical Significance	No. feet	271	369	49	174	0	863
	per cent of total	31.40	42.76	5.68	20.17	0	100
Waste Disposals in cities	No. feet	267	284	240	142	107	1040
	per cent of total	25.68	27.30	23.08	13.65	10.29	100
Story of a Mountain Glacier	No. feet	67	91	78	694	0	898
	per cent of total	7.58	10.14	8.69	77.29	0	100
The Steamboat in United States History*	No. feet	65	0	50	0	0	115*
	per cent of total	56.52	0	43.48	0	0	100
Average per cent first six films		24.60	19.92	18.20	35.48	1.80	

Table 28. The footage and the per cent of footage devoted by each film to the five classifications of content.

*The Steamboat in United States History footage represents the eight scenes and captions used in experiment thirteen. (See chapter [illegible])

This analysis shows that the actual per cent of moving or action pictures in the six* films combined is 18.20. In other words less than one fifth of these films represent action. Four of the films contain less than 14 per cent of action pictures and one film has as low as 2.89 per cent of action. The only film wherein action and movement are given prominence is the Life History of the Monarch Butterfly. This film contains 58.79 per cent of action pictures.

Fundamentally, those concepts which are dependent on motion seen would be the sort of material in which the moving picture would make a real contribution to teaching. Five of the six films under consideration were organized around topics from a point of view which did not depend on action reproduced. The films represent rather a series of still pictures and animated maps, (animated in terms of appearing and disappearing legends or a moving line) explained by concise statements in the forms of captions.

Thirty five and fourty eight hundredths per cent of the six films under discussion were made up

---

*The complete analysis of The Steamboat in United States History was not made.

of animated cartoons or maps. In the film French Explorations in North America the routes taken by the French are shown by a moving black line and the names of rivers and other legends are flashed in and out of the map. The film Waste Disposals in Cities shows animated cartoons where-in the sewage flows thru pipes, sprinklers, troughs and beds of rock and sand.

The Story of a Mountain Glacier is 77.29 per cent a picture of Mr. W. W. Atwood's chalk talk.

However, the action represented by these animated cartoons and maps is not seemingly essential to the formation of the correct concepts of these topics if the results of experimental 1,2,4,5&7 are to be taken as reliable. Furthermore the lettering which accompanies these animated cartoons and maps shows that even these are dependent on language for the complete meaning.

One fourth (24.6 per cent) of the films under discussion were made up of pure caption material. Canals in United States History ran as high as 36.98 % of captions while the Story of a Mountain Glacier had only 9.68 per cent of captions. Language is essential in teaching and the persons who would have the film surplant the text book overlook the large proportion of language material in the film itself.

Chapter XIV

SUMMARY AND CONCLUSIONS

SUMMARY. The foregoing pages present the conduct and findings of fourteen experimental attempts to compare various methods of visualinstruction. These experiments were conducted in three different school systems, namely; The Elementary School of the University of Chicago, Chicago, Illinois, the Public Schools of Evanston, Illinois and the Public Schools of Urbana, Illinois.

The total number of children who acted as subjects in these experiments as reported herein is six hundred forty-nine. These pupils ranged from the fourth to the eighth grades inclusive. Many of the pupils acted as subjects in three different experiments.

Seven moving picture films were used as instructional units, each produced by the Society for Visual Education, Incorporated, Chicago, Illinois. These films by title and classification are as follows;-

TITLE OF FILM	SUBJECT
(1) French Explorations in North America	History

(2) The Life History of the Monarch Butterfly---------------------------Nature Study

(3) The Panama Canal and Its Historical Significance-----------Economic History

(4) Canals in United States History---Economic History

(5) Waste Disposal in Cities----------Health and Sanitation

(6) Study of a Mountain Glacier-------Physical Geography

(7) The Steamboat in United States History---------------------------Economic History

Comparisons were made in the fourteen experiments between;--

(a) Film instruction and oral instruction illustrated by class-room maps; (Experiments 1 and 2)

(b) Film instruction and oral instruction plus film instruction; (Experiments 2 and 4.)

(c) Film instruction and oral instruction illustrated by still pictures or charts or sketches; (Experiments 3, 7, 8, 9 and 11.)

(d) Film instruction and stereoptican slide instruction; (Experiments 3, 5, 10 and 13.)

(e) Film instruction and stereoptican slide instruction plus film instruction; (Experiment 4.)

(f) Oral instruction illustrated by peitures or charts or sketches and stereoptican slide instruction; (Experiments 2.)

(g) Oral instruction illustrated by pictures or charts or sketches and stereoptican slide instruction; (Experiment 3.)

(h) Oral instruction plus film instruction and stereoptican slide instruction plus film instruction. (Experiment 4.)

(i) Film instruction and oral instruction given while the film was running and stopped. (Experiment 6.)

(j) Film instruction and oral instruction given while the film was running. (Experiments 6 & 12)

(k) Oral instruction illustrated by still pictures or chart or sketches and oral instruction given while the film was running. (Experiment 8.)

(l) Film instruction and oral instruction illustrated by stereographs and charts. (Experiment 10.)

(m) Oral instruction illustrated by stereographs and charts and stereoptican slide instruction. Experiment 10.)

(n) Oral instruction illustrated by stereographs and oral instruction illustrated by stereoptican slide. (Experiment 14.)

The above comparisons were made by selecting equal groups ona basis of intelligence test scores and by giving each group the same material by the different methods of instruction to be compared. The same test was given both groups and the average scores recorded and evaluated.

The length of time involved in each instruction period was kept constant.

The groups were rotated so that different methods of instruction could be given to each group. Furthermore, in all the experiments but one, eight, nine and fourteen,

duplicating experiments were run in another grade or school to serve as a check.

CONCLUSION. Let us go back to experiment one and raise again the three questions brought forward at that point concerning the method of experimentation described herein. One might say; first, that these films were not the best films to teach these units of material; second, that the pupils were trained to learn more economically under ordinary class-room methods than from a film which is a relatively new method of presenting material to children; and third, that the tests did not test all the desirable outcomes of film or picture instruction.

The first question involves the problem of best methods of teaching. Let us grant that the films might have been organized so that their use as an instructive unit would have been greatly enhanced. The oral instruction could likewise have been improved. Furthermore, the reader should bear in mind that these experiments were not organised to determine what is or is not the best method of teaching a film, but rather to determine which unit of material as organized and described in the foregoing pages, would impart the most information to pupils in a given time.

It is obvious that if the writer had an experimentally proven unit of material in film form and an experimentally proven unit of material in illustrated-oral-instruction form that a comparison between these two units would be more valuable than the same comparison reported herein.

In answer to the second question it has been pointed out that the pupils taking part in all of the experiments (with the exception of the pupils in the Leal School, Urbana, Illinois) had had instruction and experience in learning from pictures and films. Had this factor been of real importance the pupils in the film groups who had been thru a second or third experiment would have made scores much higher in proportion than they did in the first experiment. An inspection of the results shows that this is not the case.

The third question raised above points out clearly that the experiments reported herein are limited to a consideration of the factual knowledge which each group obtained from an exposure to the presentation in terms of the amount gained, its characteristics and the amount retained.

The writer feels justified in drawing the following conclusions in terms of the factual knowledge

imparted to the pupils involved in the fourteen experiments, under the conditions of these experiments and on a basis of the evidence reported;-

(1) The film entitled "French Explorations" is not as effective as a teacher using classroom maps in imparting to pupils the information concerning the routes and portages made by the French explorers.

(2) Oral instruction illustrated by maps followed by film instruction is more effective than pure film instruction.

(3) The oral discussion read before the film was shown on the Panama Canal to group C, Central School, in experiment four is not as effective as a single showing of the film itself or as a stereoptican lecture.

(4) A stereoptican lecture followed by film instruction is more effective than two showings of the same film.

(5) A stereoptican lecture is more effective than the film in teaching material such as that contained in the unit the "Panama Canal and Its Historical Significance."

(6) When the location of the important places is the prime consideration, a close-up relief map of the Panama Canal Zone taught by a stereoptican slide and a teacher is far superior to a flat outline map in black and white taught by the film.

(7) The film entitled "The Life History of the Monarch Butterfly" is slightly inferior to oral instruction illustrated by stereoptican slides and to oral instruction illustrated by pictures and sketches, in imparting to pupils the information concerning the Life History of the Monarch Butterfly.

(8) Place sequence is taught, under the conditions of experiment one, two, and seven, more effectively by teacher-chart instruction than by film instruction.

(9) Film instruction results in a large number of pupils securing ideas and factual information which are disconnected when place sequence is taught. The teacher-chart situation results in a connected series of ideas and factual information.

(10) Pupils exposed to teacher-chart instruction make more sequential errors than pupils instructed by a moving picture film when place sequence is taught.

(11) It is more effective to give verbal explanation during the showing of a film than to present the film without comment, provided the person giving the verbal explanation has seen the film before the presentation and has worked out his statements carefully.

(12) Films containing a high per cent of action pictures are more effective than still pictures for presenting certain types of material and approach the teacher situation in effectiveness.

(13) Language is a necessary accompaniment of concrete experience.

(14) The motion picture films herein described are inflexible units which lack the flexibility of the teacher-language-chart situation. This can be remedied in part by stopping the film for comment or by explanatory material given during the projection of the film. (Note. The words stereograph, slide, still-picture, map or diagram can be substituted for the word "chart", in the compound word "teacher-language-chart" above, with the same meaning.)

(15) Groups making the highest scores in the original information tests show a greater per cent of loss in the memory tests indicating that these groups were able to excel/ in the more difficult parts of the original test.

(16) The attention of pupils to the presentation of a moving picture film is not one hundred per cent, and is not appreciably higher than the attention of pupils to the teacher-chart situation.

(17) The teacher's selective power to call the attention of the pupils to important facts and relationships is missing in the films herein described and should be supplied if possible.

(18) The stereograph is seemingly superior to the stereoptican slide or film as a supplementary aid in teaching material such as "The story of a mountain glacier."

(19) The stereograph used to supplement a study period in geography is more effective than the stereoptican slide used to summarize the period of study.

(20) In order to be effective moving picture instruction must be connected up with the pupil's past experience in terms of language.

While these experiments and the conclusions which may be drawn from their results make no claim to being exhaustive they may be of some value to the future investigator in visual education and the teacher who would make use of visual education's materials.

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